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ABSTRACT

This document presents the basic test data obtained during the Lift-Propulsive Force Limit Wind Tunnel Test conducted during 1976 at the Boeing Vertol Wind Tunnel. Included are the rotor control positions, blade loads and six components of rotor force and moment, corrected for hub tares. Performance and blade loads are presented as the rotor lift limit is approached at fixed levels of rotor propulsive force coefficients and rotor tip speeds. Performance and blade load trends are presented for fixed levels of rotor lift coefficient as propulsive force is increased to the maximum obtainable by the model rotor. Test data is also included that defines the effect of stall proximity on rotor control power. This test data is presented in Volume II and III and the analysis of the data is presented in Volume I.

FOREWORD

This report was prepared by the Boeing Vertol Company for the National Aeronautics and Space Administration, Langley Research Center, under NASA contract NAS1-14317. It presents the test data and analysis from the Lift-Propulsive Force Limit Wind Tunnel Test. The analysis of the data establishes the useful flight envelope and the characteristics of a conventional rotor in high speed flight. The results are presented in three volumes.

-1 Wind Tunnel Investigation of Rotor Lift and
Propulsive Force Limits at High Speed -
- Data Analysis -

-2 & -3 Wind Tunnel Investigation of Rotor Lift
and Propulsive Force Limits at High Speed -
- Test Data Appendix -

Mr. J. L. Jenkins (NASA Langley) was the technical monitor for this work.

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NOMENCLATURE

<u>Symbol</u>	<u>Definition</u>	<u>Units</u>
A	Rotor Area (πR^2)	m ² (ft ²)
A ₁ , a ₁	1st Harmonic Longitudinal Flapping Angle	rad(deg)
A ₁	Lateral Cyclic (-θ at ψ = 0°)	rad(deg)
B ₁ , b ₁	1st Harmonic Lateral Flapping Angle	rad(deg)
B ₁	Longitudinal Cyclic (-θ at ψ = 90°)	rad(deg)
CB12	Alternating Root Chord Bending Moment at 12% Blade Radius (P+P)/2	kg-m(in-lb)
CB53	Alternating Mid Span Chord Bending Moment at 53% Blade Radius (P+P)/2	kg-m(in-lb)
CDE/SB	Rotor Effective Drag Coefficient = $DE/\rho AV_{TIP}^2 \sigma$	
CH/SB	Rotor Longitudinal Force Coefficient = $H_{FORCE}/\rho AV_{TIP}^2 \sigma$	
CPMB	Rotor Pitching Moment = $PM/\rho AV_{TIP}^2 R$	
CP/SB	Rotor Power Coefficient = $Q/\rho AV_{TIP}^2 R \sigma$	
CRMB	Rotor Rolling Moment Coefficient = $RM/\rho AV_{TIP}^2 R$	
CT'/SB	Rotor Lift Coefficient = $L/\rho AV_{TIP}^2 \sigma$	
CX/SB	Rotor Propulsive Force Coefficient = $X/\rho AV_{TIP}^2 \sigma$	
CY/SB	Rotor Side Force Coefficient = $S.F./\rho AV_{TIP}^2 \sigma$	
FB12	Alternating Root Flap Bending at 12% Blade Radius (P+P)/2	kg-m(in-lb)
FB22	Alternating Inboard Flap Bending Moment at 22% Blade Radius (P+P)/2	kg-m(in-lb)

<u>Symbol</u>	<u>Definition</u>	<u>Units</u>
FB48	Alternating Mid Span Flap Bending Moment at 48% Blade Radius $(P+P)/2$	kg-m(in-lb)
FB79	Alternating Outboard Flap Bending Moment at 79% Blade Radius $(P+P)/2$	kg-m(in-lb)
PM	Hub Pitching Moment	m-kg(ft-lb)
Q	Rotor Torque	kg-m(lb-ft)
R	Rotor Radius	m(ft)
RM	Hub Rolling Moment	m-kg(ft-lb)
SF	Rotor Side Force	kg(lb)
T	Rotor Thrust	kg(lb)
TB12	Alternating Root Torsion at 12% Blade Radius = $(P+P)/2$	kg-m(in-lb)
TB20	Alternating Inboard Torsion at 20% Blade Radius = $(P+P)/2$	kg-m(in-lb)
TB51	Alternating Mid Span Torsion at 51% Blade Radius = $(P+P)/2$	kg-m(in-lb)
TB81	Alternating Outboard Torsion at 81% Blade Radius = $(P+P)/2$	kg-m(in-lb)
V	Tunnel Velocity	m/s(ft/s)
V _{TIP}	Rotor Tip speed	m/s(ft/s)
X	Rotor X Force	kg(lb)
α_s	Shaft Angle of Attack	rad(deg)
θ	Collective Pitch	rad(deg)
μ	Advance Ratio = V/V_{TIP}	

<u>Symbol</u>	<u>Definition</u>	<u>Units</u>
ρ	Tunnel Density	N/m^2 (slugs/ft ²)
σ	Rotor Solidity $bc/\pi R$	

TABLE 5.1 RUN LOG (continued)

TYPE OF TESTING	RUN NO.	ROTOR TIP SPEED V_T	ADVANCE RATIO μ	ROTOR LIFT COEFF. C_L/σ	ROTOR PROPULSIVE FORCE COEFF $X/qd^2\sigma$	TUNNEL SPEED V	COMMENTS
BASELINE ROTOR CHARACTERISTICS	219	Range			0	For μ	Blade Frequency Check
CHECK AND VERIFICATION RUNS	221 222 224 225 226 227	620 FPS	.53 .50 .50 .45	Range	.05 .05 .05 .05 .05	328 310 FPS 310 FPS 279 FPS	These runs were made to verify that the rotor performance on Part 1 and Part 2 were consistent and did not include any model fouling
LIFT LIMIT TESTING	228 245 246 249	620 FPS	.57	Range	.05 .025 .025 .10	353 FPS	Cruise performance and lift limits at baseline rotor tip speed
	229 248	620 FPS	.61	Range	.05 .075	378 FPS	
	250 251 252 253	570 FPS	.40 .45 .50 .53	Range	.05	228 FPS 256 FPS 285 FPS 302 FPS	Cruise performance and lift limits at reduced rotor tip speed to define effect of advancing tip Mach number
	256 255 254 257 258 259 260	570 FPS	.40 .45 .50 .53 .57 .61 .64	Range	.05	228 FPS 256 FPS 285 FPS 302 FPS 325 FPS 348 FPS 368 FPS	
	230 231	620 FPS	.40	.06 .09	Range	248 FPS	Cruise performance and propulsive force limits at baseline tip speed
	243 244	620 FPS	.45	.06 .076	Range	279 FPS	
	232 233 234 235	620 FPS	.50	.06 .06 .08 .08	Range	311 FPS	

6.0 TEST DATA OPERATION

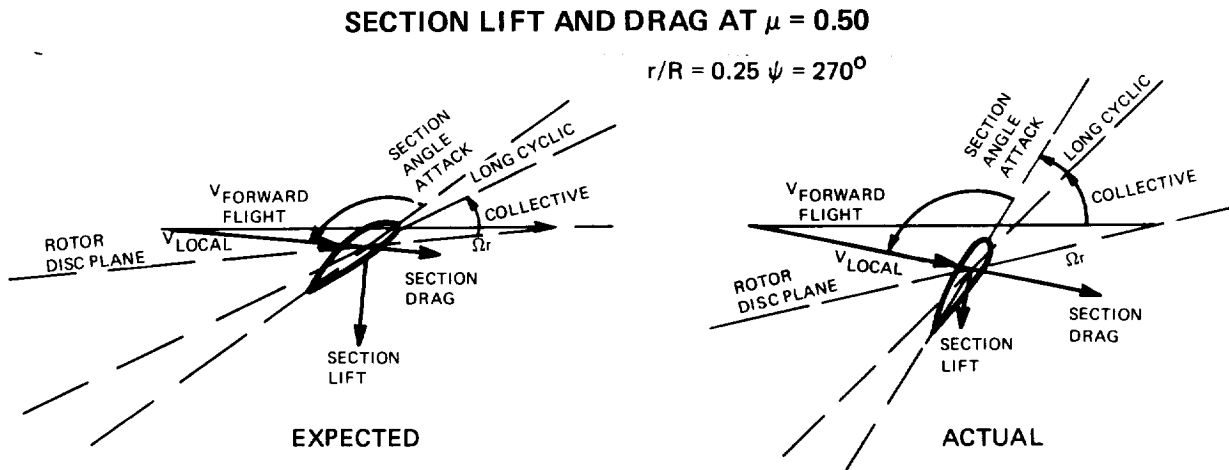
As defined in Section 5, the overall program objective was to define the performance characteristics of a conventional helicopter rotor in high speed forward flight. Six specific test objectives were presented in Section 5.3, in order of priority, and will be discussed in the following sections. Additional areas of test data analysis are included that examine the rotor operation in and out of stall, summarize the model performance and indicate the importance of drag cleanup, correlate theory and test data and show the impact of reduced torsional stiffness.

For the testing and data analysis, the primary rotor tip speed is 620 ft/sec (189 m/sec) and a propulsive requirement defined in coefficient form is $X/qd^2\sigma = 0.05$ which is representative of an advanced helicopter level of drag cleanup. Variation in propulsive force and rotor tip speed are examined to show the impact on the basic trends defined.

Having demonstrated an aerodynamic limit in lift, it is necessary to examine the blade loads to insure that a load limit has not been reached or exceeded. The most critical load is alternating blade root torsion, therefore, the corresponding variation of alternating blade root torsion load with rotor lift coefficient must be monitored at the same time to insure that the limit of 50 in.lb. was not exceeded. Figure 6.1.2 presents this variation but the maximum load indicated was approximately 60 percent of the limit. Since the lift was not limited by loads and we reached an aerodynamic limitation there was obviously no control system limitation for this case. There were only a few cases where longitudinal and lateral cyclic capability limited the testing and there were no limitations imposed on the testing by blade loads.

A summary of the rotor lift limit for the basic propulsive force coefficient of 0.05 is presented in Figure 6.1.3 from hover ($\mu = 0.0$) to 225 knots ($\mu = 0.61$). The lift limit shown at $\mu = 0.0$ was defined by the maximum collective pitch attainable with the normal length pitch links. For the high speed testing a set of long pitch links were used but no hover data was obtained with them. The trend of lift limit with advance ratio is approximately linear up to a $\mu = 0.35$, beyond this value the lift decreases rapidly to a C_T/σ of 0.098 at $\mu = 0.45$. From $\mu = 0.45$ to 0.50 the lift limit rises rapidly and levels off at a value of $C_T/\sigma = 0.112$ out to $\mu = 0.53$. After this advance ratio the lift limit drops to C_T/σ of 0.072 at 225 knots ($\mu = 0.61$). The

rotor lift between an advance ratio of 0.50 and 0.53 as shown below.



Also the reverse flow region is reduced significantly by the increased shaft angle, thereby producing a smaller degradation at high advance ratio than anticipated. Beyond an advance ratio of 0.53 the dynamic pressure and working blade area continue to increase in reverse flow. There is also a change in angle of attack produced by the increase in collective and longitudinal cyclic with advance ratio. The combined change in angle of attack dynamic pressure and blade area in reverse flow could result in both lift and drag acting in a direction that reduces lift, or the drag produces a significantly large component of negative rotor lift and offsets the positive contribution of local lift.

To provide some insight into the stall impact on the lift and the change in characteristics with advance ratio, an examination of the flap bending and torsion loads in Figures 6.2.15 through 6.2.22 were combined to provide a qualitative assessment of the

is increased up toward the limit, the lift is increased in the inboard forward portion of the rotor and on the outboard aft portion of the rotor. The amount of negative lift generated on the inboard portion of the rotor appears to increase as indicated by the torsion and flap bending loads. On the outboard region of the rotor that had negative lift becomes smaller. Although qualitative, the lift distributions indicated would produce blade deflections that were representative of those observed visually during the testing.

As shown in Figure 6.1.1 the effect of propulsive force on the lift limit was also defined by the testing at advance ratios of 0.40 and above. A summary of the lift limit at propulsive force coefficients ($X/qd^2\sigma$) of 0.025, 0.10 and 0.20 is presented in Figure 6.1.6 and compared with the basic lift limit shown in Figure 6.1.3. Reducing the $X/qd^2\sigma$ to 0.025 resulted in no change between $\mu = 0.40$ and 0.50 but there was an increase in lift limit (C'_T/σ) of 0.008 at an advance ratio of 0.53. Increasing $X/qd^2\sigma$ from 0.05 to 0.10 resulted in a decrease in lift limit (C'_T/σ) of 0.01 between $\mu = 0.40$ to 0.50 and the decrement in lift limit (C'_T/σ) increases to 0.03 beyond an advance ratio of 0.50. Similar changes were established when the propulsive force coefficient was increased from 0.10 to 0.20.

To define the propulsive force limit, a sweep in propulsive force coefficient was made at a fixed level of rotor lift coefficient. As discussed previously in Section 5.2, the propulsive force was

The lift limits that were defined in Figure 6.1.6 can also be presented as an operational envelope of rotor lift and rotor propulsive force coefficient. This has been done in Figure 6.1.10 and the restriction imposed by an advance ratio of 0.45 is almost as severe as operating at an advance ratio of 0.61. Further study of all the data at an advance ratio of 0.45 is required to determine the cause of reduced capability.

The maximum lift obtained at specific level of propulsive force or the maximum propulsive force obtained at fixed levels of rotor lift combine to establish a restriction on the operational capability of the model rotor system. This in essence is the combination of Figures 6.1.10 and 6.1.9 into an overall operational envelope and is presented in Figure 6.1.11.

Superimposed on Figure 6.1.11 is an equivalent flat plate drag area loading $GW/fe = 1500 \text{ lb/ft}^2$, a drag level representative of an advanced helicopter. This established the flight envelope for the model rotor system and specifies that the rotor can operate at a rotor lift coefficient $C_T'/\sigma = 0.10$ up to an advance ratio of 0.57 or 210 knots. Flight at an advance ratio of 0.61 or 225 knots can be achieved when operating at a $C_T'/\sigma = 0.08$. This answers the repeatedly asked question - can the conventional rotor operate at useful lift levels in high speed forward flight without auxiliary lift or auxiliary propulsion? - with a firm YES.

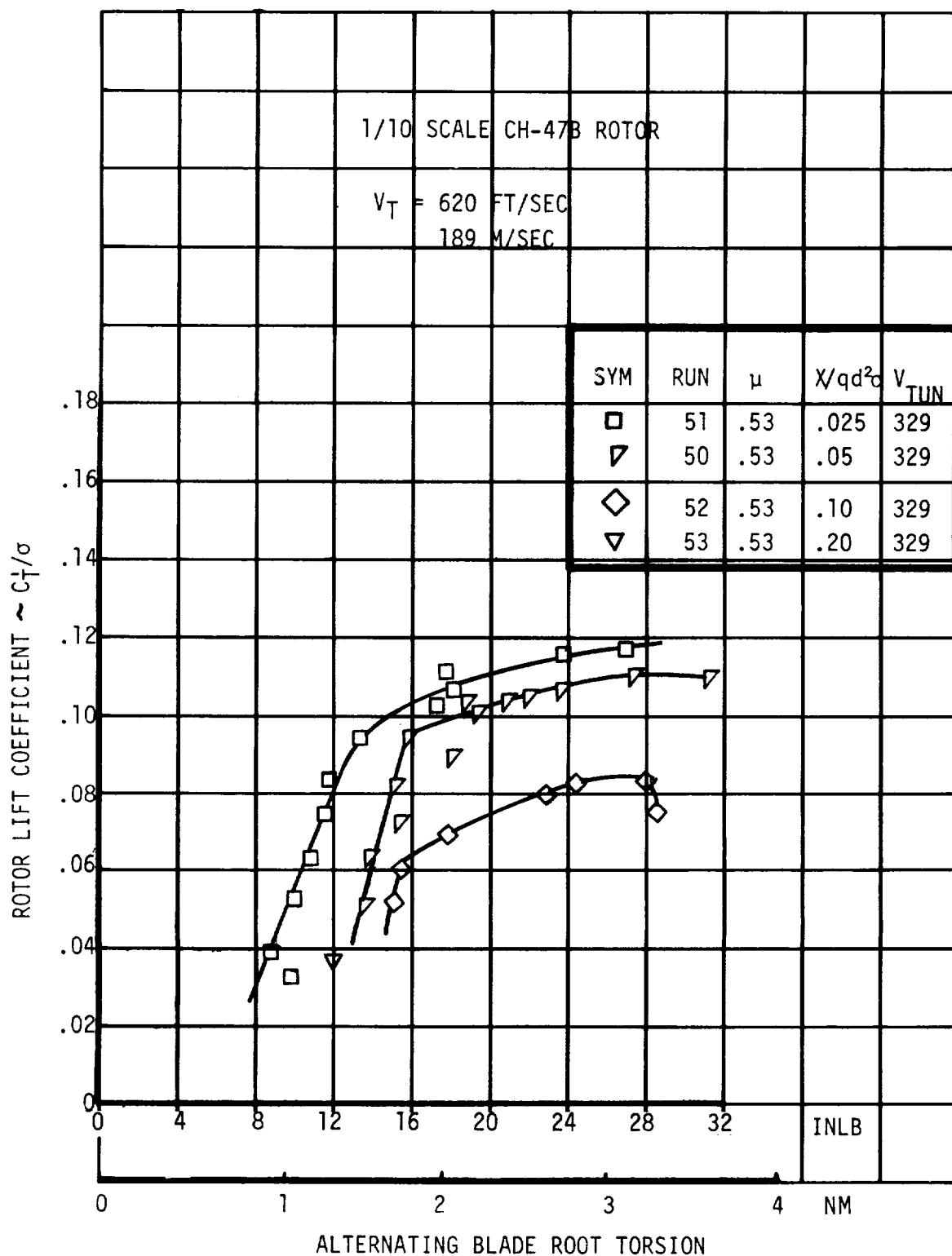


FIGURE 6.1.2 LIFT LIMIT NOT DEFINED BY BLADE LOADS

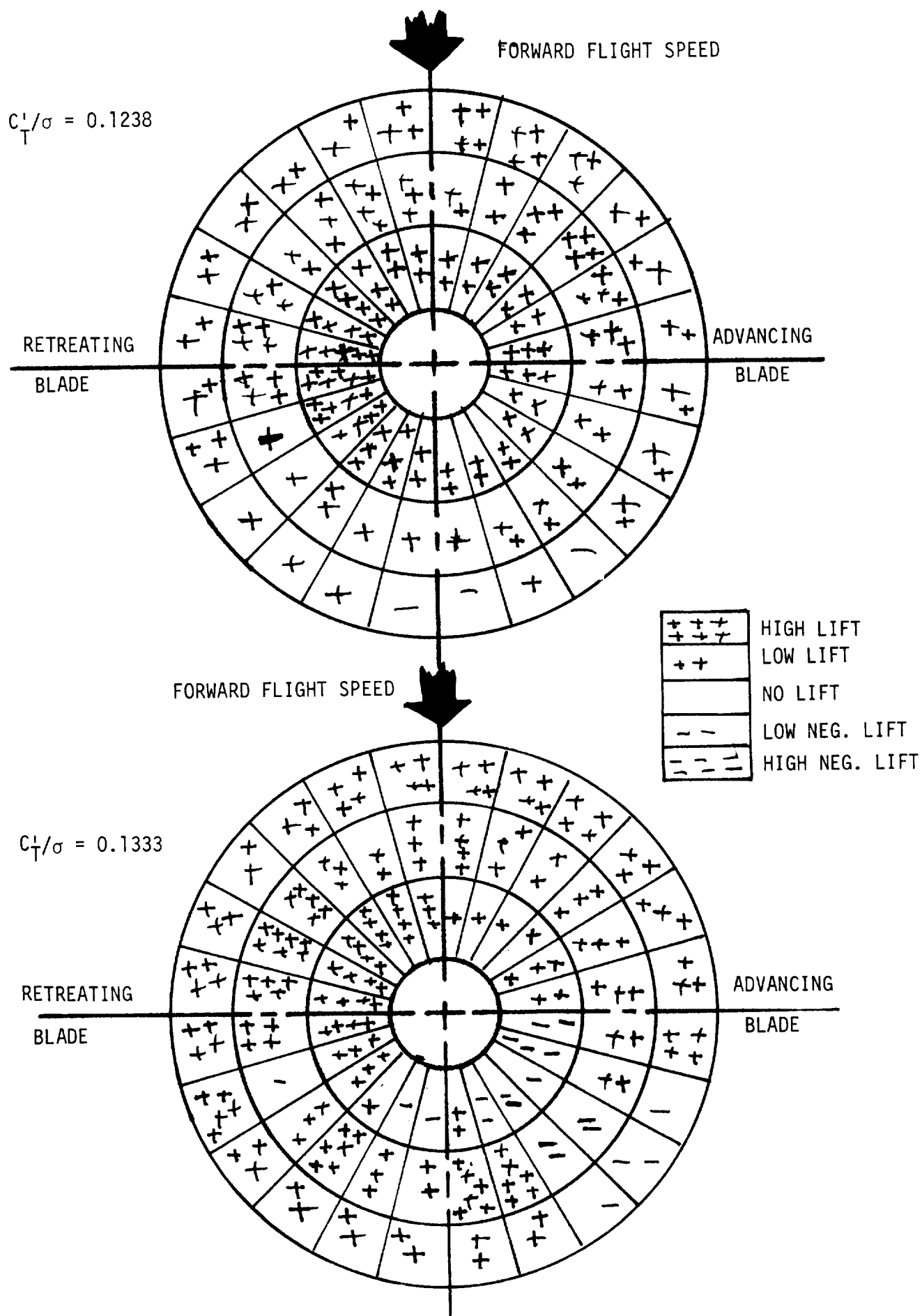


FIGURE 6.1.4 LIFT DISTRIBUTION ESTIMATED FROM TORSION LOADS
 AT $\mu = 0.20$ AND $X/qd^2\sigma = 0.05$

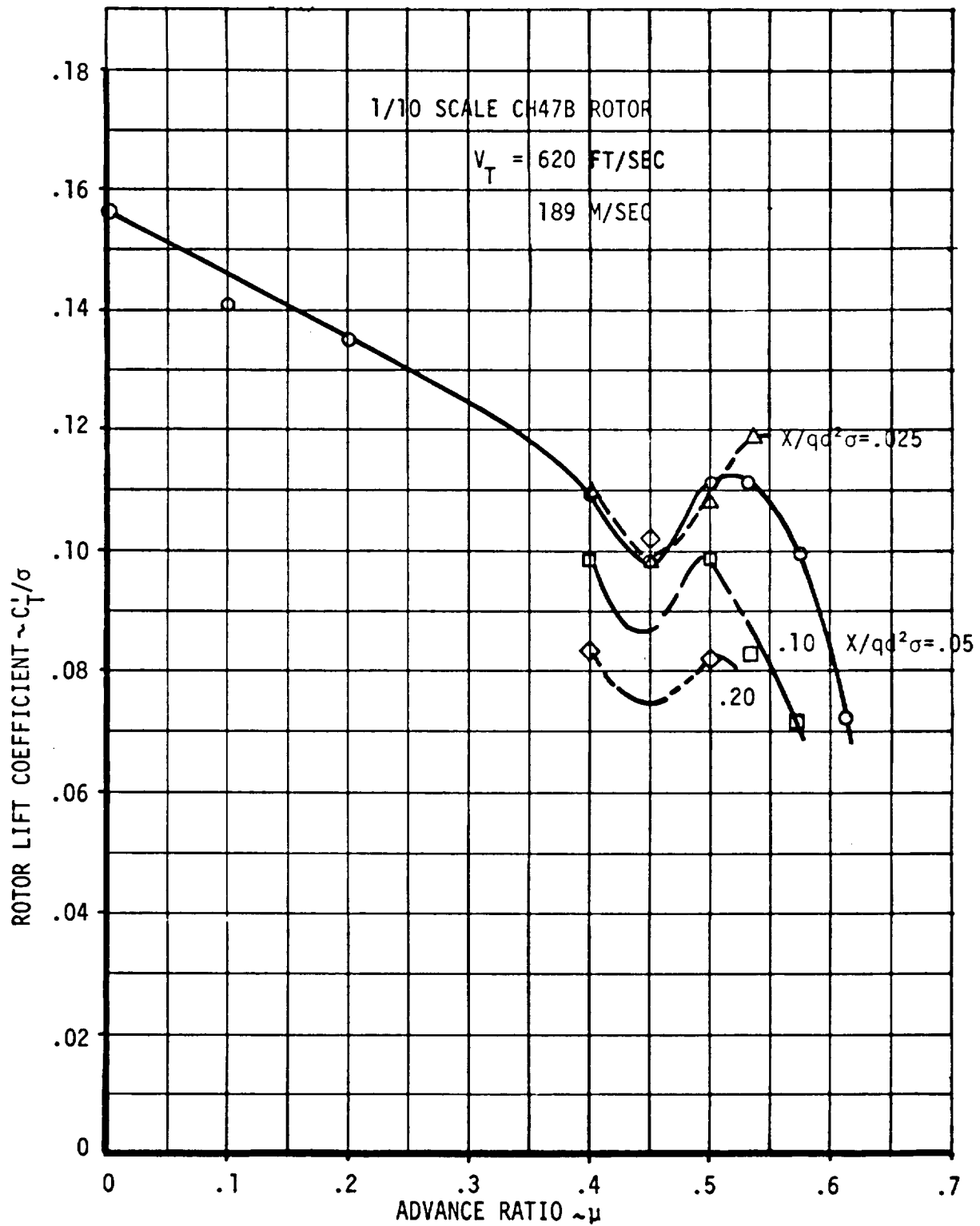


FIGURE 6.1.6 EFFECT OF PROPULSIVE FORCE REQUIREMENTS ON MAXIMUM LIFT LIMIT

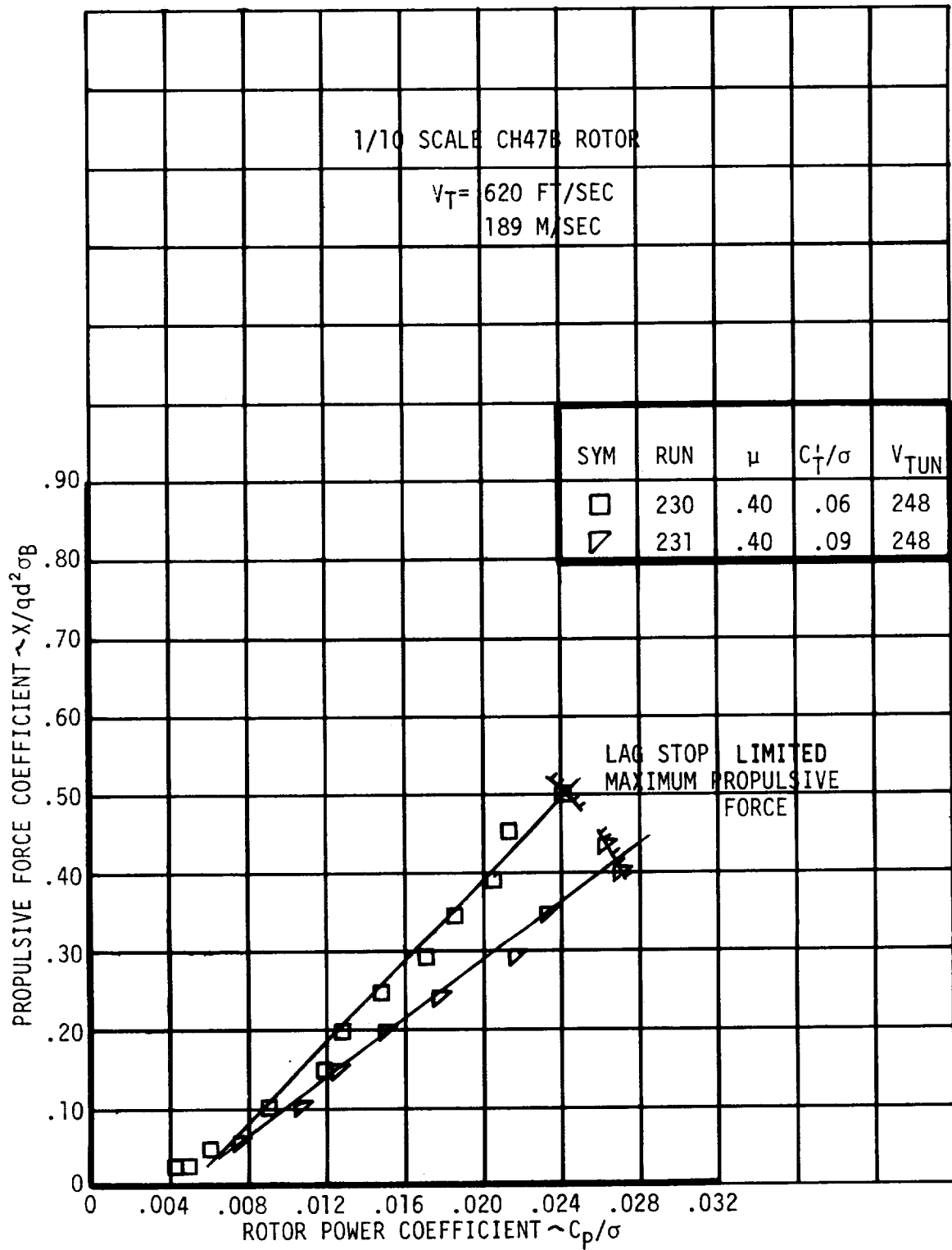


FIGURE 6.1.8 PROPULSIVE FORCE LIMIT NOT DEFINED BY AERODYNAMICS

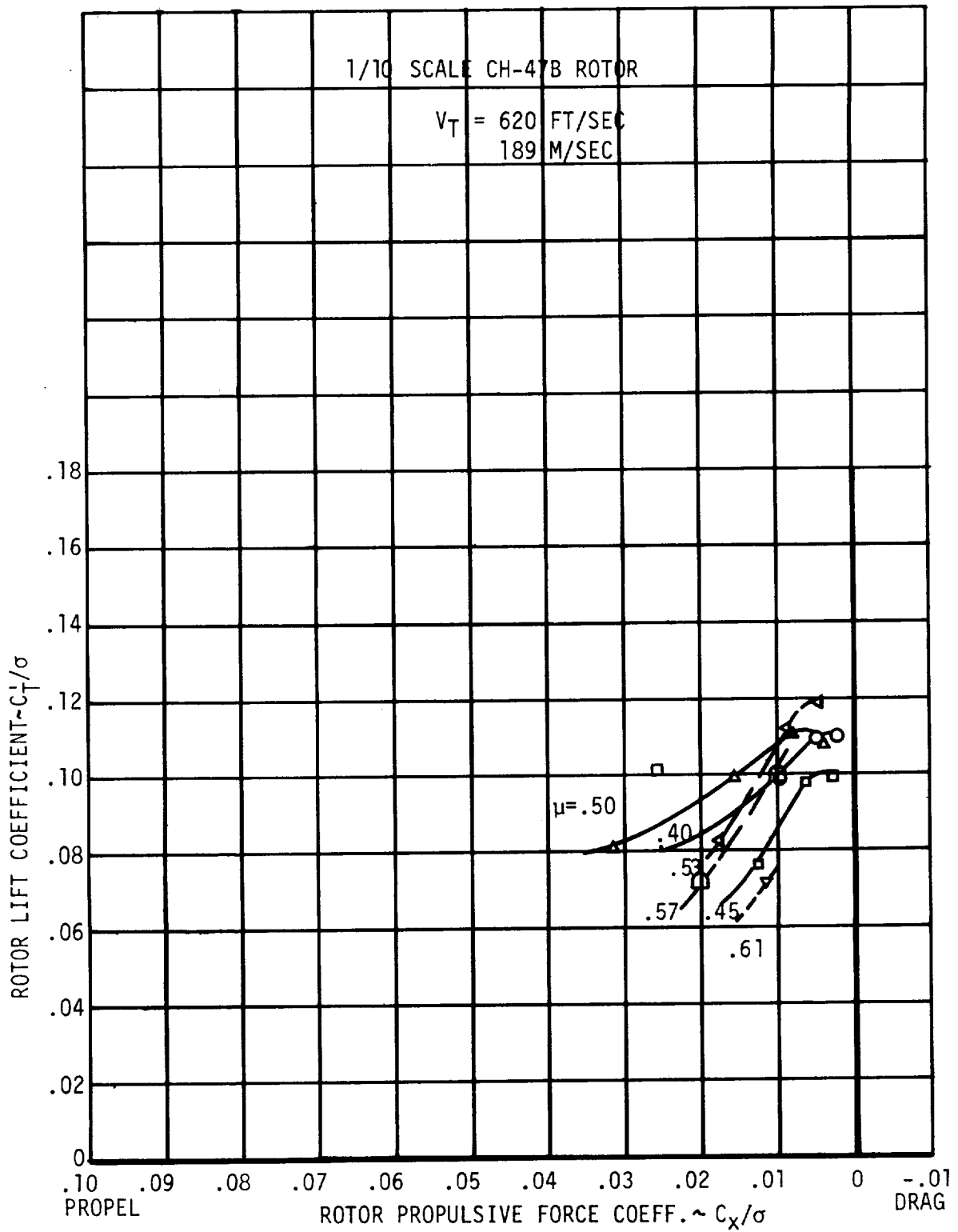


FIGURE 6.1.10 LIFT-PROPULSIVE FORCE ENVELOPE AT THE LIFT LIMIT

6.2 Blade Load Growth Approaching Limits

Test Objective 2: Establish the blade load growth as the lift approaches the limit

Before discussing the load characteristics, it is necessary to establish the blade frequency trends with RPM to insure that there are no critical resonances at the operating conditions. The frequency spectrum for the model rotor blade, as shown in Figure 6.2.1, was obtained from an RPM sweep at an advance ratio of 0.20 and a rotor lift coefficient of 0.10. The first torsion mode and six per rev coalesce at 2100 RPM and the third flap mode and seven per rev also coalesce at 2100 RPM, but normal operation at the basic tip speed of 620 ft/sec is at 2005 RPM. This is sufficiently removed from the resonances to avoid severe load amplification. At the alternate tip speed of 570 ft/sec, a rotor speed of 1840 RPM, there is a coalescence of the second chord mode with the eight per rev but this is not a critical resonance condition.

The loads of torsion, flap and chord bending were measured at ten locations on the blade as described in Section 3.3, presented in Appendix A and summarized in Figures 6.2.2 through 6.2.4. Of these loads, torsion was the load to be monitored most critically since it indicates the presence of stall and had the smallest margin with the anticipated loads. A summary of the alternating blade root torsion loads are presented in Figure 6.2.2

increasing lift is very gradual but for the lift limit, shown in the upper part of the figure, there is an increase in load occurring outboard on the blade. Similar trends are exhibited for an advance ratio of 0.20 as shown in Figure 6.2.6 but the magnitude increases. At an advance ratio of 0.40, a typical load variation is shown for the outboard 20 percent of blade ($r/R = 0.80$ to 1.00) in Figure 6.2.7. The distinct difference in the distribution at $\mu = 0.4$ with that at $\mu = 0.20$ or 0.0 is demonstrated by the uniform increase in the alternating torsion load from the outboard station, $r/R = 0.80$ to the point where the blade ends $r/R = 0.20$. This may result from the direct trade in section pitching moment coefficient with section dynamic pressure. Figure 6.2.8 presents the radial distribution for an advance ratio of 0.50. Trends for the outboard half of the blade were similar to that shown for $\mu = 0.40$ with an increase in magnitude. The load growth between $r/R = 0.50$ to 0.20 is twice as great as that presented for $r/R = 0.80$ to 0.50 which appears to be the impact of the increased forward speed on the inboard portion of the blade either on the advancing or retreating blade. Figure 6.2.9 presents the data for an advance ratio of 0.57 and the trends shown are similar to those for $\mu = 0.50$.

To better understand the load growth with lift, the blade root torsion waveforms have been superimposed on the alternating root torsion loads of Figure 6.2.2 for the same advance ratios of Figures 6.2.5 to 6.2.9. Figure 6.2.10 presents the loads and

torsion load at 240 degrees rotor azimuth, indicating conventional tip stall, and a sharp decrease in nose down load at 300 degrees rotor azimuth possibly reflecting more negative stall.

As the advance ratio is increased to 0.50, the blade torsion load becomes even positive at 300 degrees of rotor azimuth for rotor lift coefficients as low as 0.060, as established in Figure 6.2.13. As C_T'/σ is increased to 0.095 the magnitude of the root torsion load at a rotor azimuth of 300 degrees becomes more positive while the load at an azimuth angle (ψ) of 150 degrees becomes more negative. At the rotor lift limit ($C_T'/\sigma = 0.11$) the positive load at $\psi = 300$ degrees becomes more positive while there has developed an apparent region of stall near a rotor azimuth of 150 degrees and 240 degrees. For an advance ratio of 0.57 the alternating blade root torsion load and also the wave forms are presented in Figure 6.2.14. There is a large nose up load even at a low rotor lift coefficient of 0.060 and is significantly greater than that shown in Figure 6.2.13 for an advance ratio of 0.50. As the lift is increased to 0.087 there is the apparent stall region, defined by the two peaks in nose down load at a rotor azimuth of 150 degrees and 240 degrees. The load at 300 degrees rotor azimuth becomes a significantly large nose up load.

The discussion has presented the radial distribution of the alternating load measured around the azimuth or the azimuthal distribution of the alternating blade root torsion load. In an effort

Referring back to Figure 6.2.2 as the rotor lift is increased above $C_T'/\sigma = 0.129$ the alternating load increases very rapidly, becoming almost asymptotic. It is necessary to determine the cause of this rapid increase in loads and how it is different from the load growth caused by the inboard conventional stall. Figure 6.2.16 presents the three azimuthal distributions for the lift limit $C_T'/\sigma = 0.1333$. The outboard torsion load distribution is approximately uniform from 90 degrees all the way around to 30 degrees azimuth with an increase near 290 degrees possibly caused by stall. Between 30 degrees to 90 degrees the moment increased to a slightly positive value, usually the result of operating at negative angles of attack which would be expected with the lateral hub moments trimmed to zero. The mid blade distribution is approximately uniform between 40 degrees and 210 degrees but the remainder of the wave form shows three distinct peaks in the torsion load. The frequency of these nose down load growths is 6/rev which is the torsional natural frequency definitely establishing stall. The inboard wave form indicates a slight increase in the torsion load at 270 degrees, 315 degrees and 20 degrees azimuth which are the same regions where stall was exhibited on the mid blade trace and is possibly a carry-over of stall to the inboard portion of the blade. Therefore, the increase in the load sensitivity with lift is a result of stall shifting out to the mid and outboard portions of the blade.

the mid blade wave form by increased nose down loads at 240 degrees, 310 degrees and 20 degrees azimuth. The inboard portion indicates conventional stall at 150 degrees and 210 degrees while there is a very large increase in nose up torsion load at 300 degrees rotor azimuth. Again, the change in torsional load sensitivity at high levels of rotor lift results from a significant amount of conventional stall on the mid blade and inboard portion of the blade. The sensitivity for high levels of lift at an advance ratio of 0.50 is less than at 0.20 and appears to be the influence of the large negative stall on the inboard portion of the blade.

Similar characteristics can be generated with the flap bending loads which will indicate the regions of the rotor that are producing high lift and help confirm the regions where the rotor is encountering stall. Figures 6.2.19 to 6.2.22 present mid span and root flap bending wave forms and also an indication of the incremental outboard ($r/R=0.48$ to 1.00) and inboard ($r/R=0.12$ to 0.48) lift distribution around the azimuth. At a rotor lift coefficient of 0.1238 and an advance ratio of 0.20, there is a region of negative flap bending load between 90 degrees and 150 degrees azimuth for the outboard blade region as shown in Figure 6.2.19. For the inboard portion of the blade there is a region of very high flap bending loads between 60 degrees and 150 degrees and slightly reduced load level from 150 degrees to

coefficient of 0.1029. The increase in lift on the outboard portion of the blade between 210 degrees and 330 degrees provide support to the mid blade stall indicated in Figure 6.2.18. The very high lift between 120 degrees and 240 degrees azimuth supports the conventional stall on the inboard blade while the negative lift or download occurring between 240 degrees and 270 degrees verifies the operation at large negative angles of attack and the negative stall defined in Figure 6.2.18 for the inboard section of the blade. This estimated lift distribution data in addition to the torsion data of Figures 6.2.15 through 6.2.18 provided the basis for the qualitative lift distributions presented in Section 6.1.

To summarize the results there is an inboard stall that produces a moderate increase load sensitivity with lift and a mid blade plus outboard stall that results in the almost asymptotic variation of loads with lift coefficient for low advance ratios. For the high advance ratios there is an inboard stall that has a higher sensitivity with lift than the low advance ratios have. For rotor lift levels near the lift limit there is a decrease in sensitivity to rotor lift for the higher advance ratio. This is a result of operating at negative section angles of attack, negative lift between 240 degrees and 270 degrees azimuth and positive section pitching moments alleviating the load growth with rotor lift. Addition analysis of the loads data in conjunction

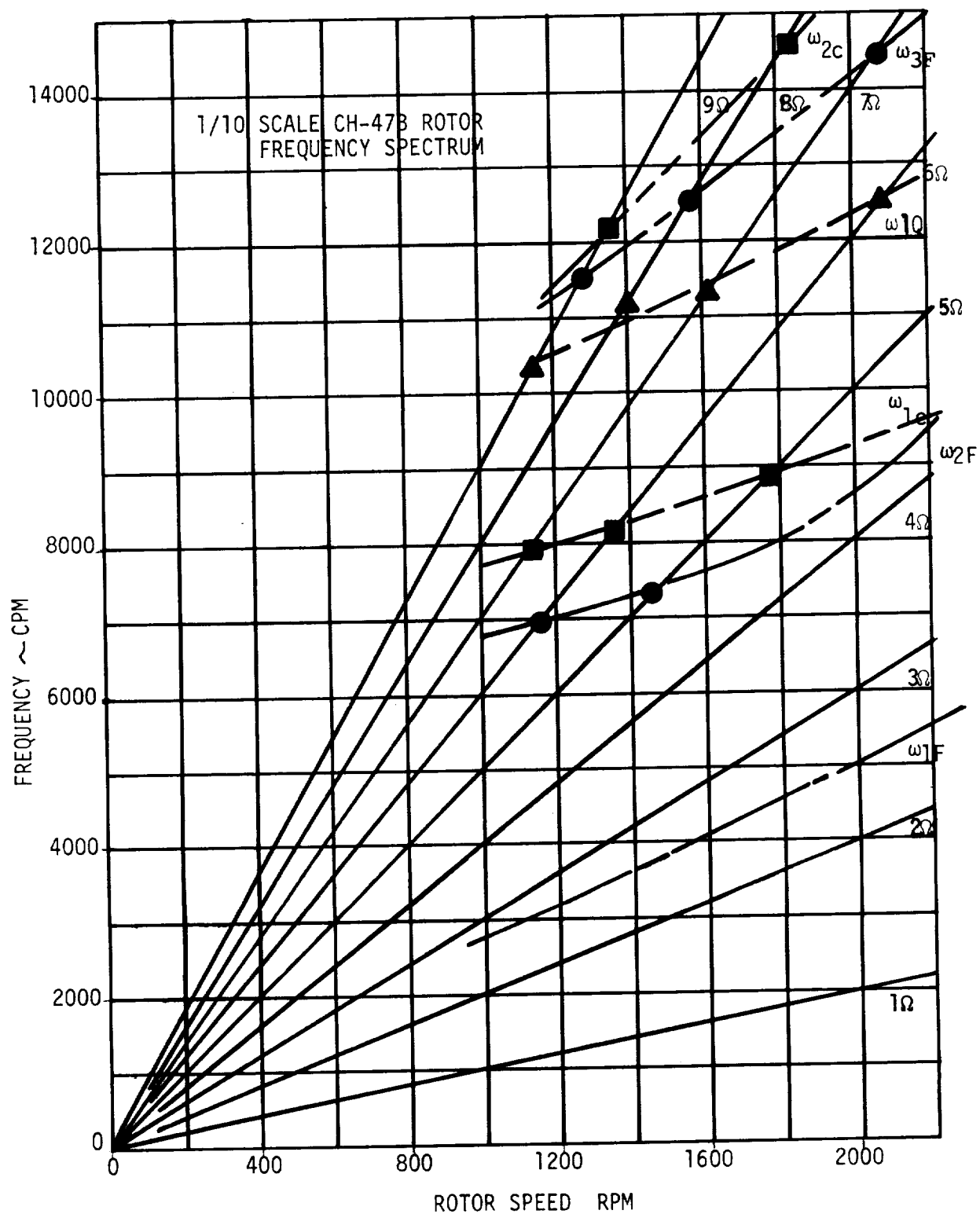


FIGURE 6.2.1 FREQUENCY SPECTRUM FOR 1/10 SCALE CH-47B ROTOR

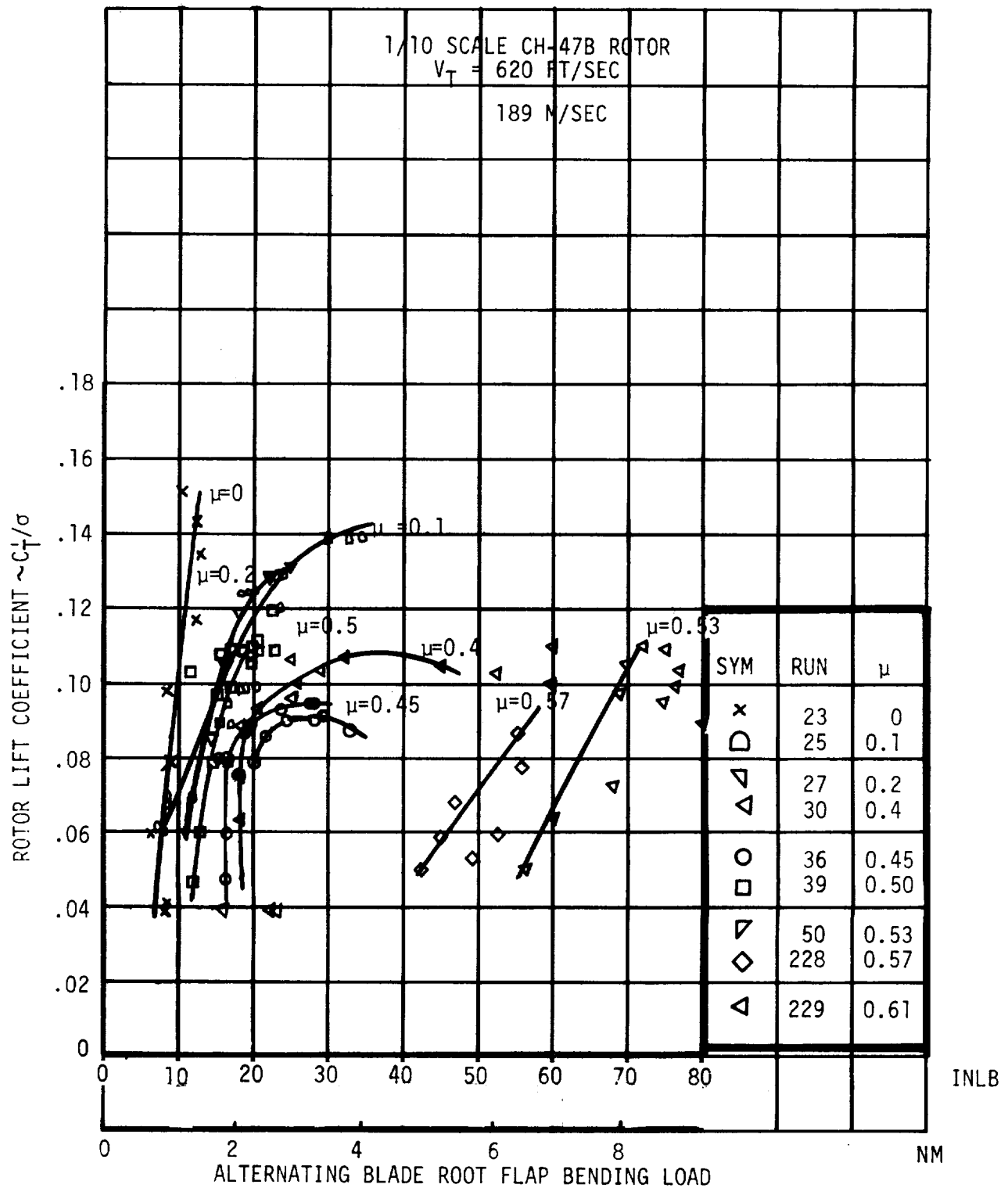


FIGURE 6.2.3 SUMMARY OF ALTERNATING BLADE ROOT FLAP BENDING LOADS

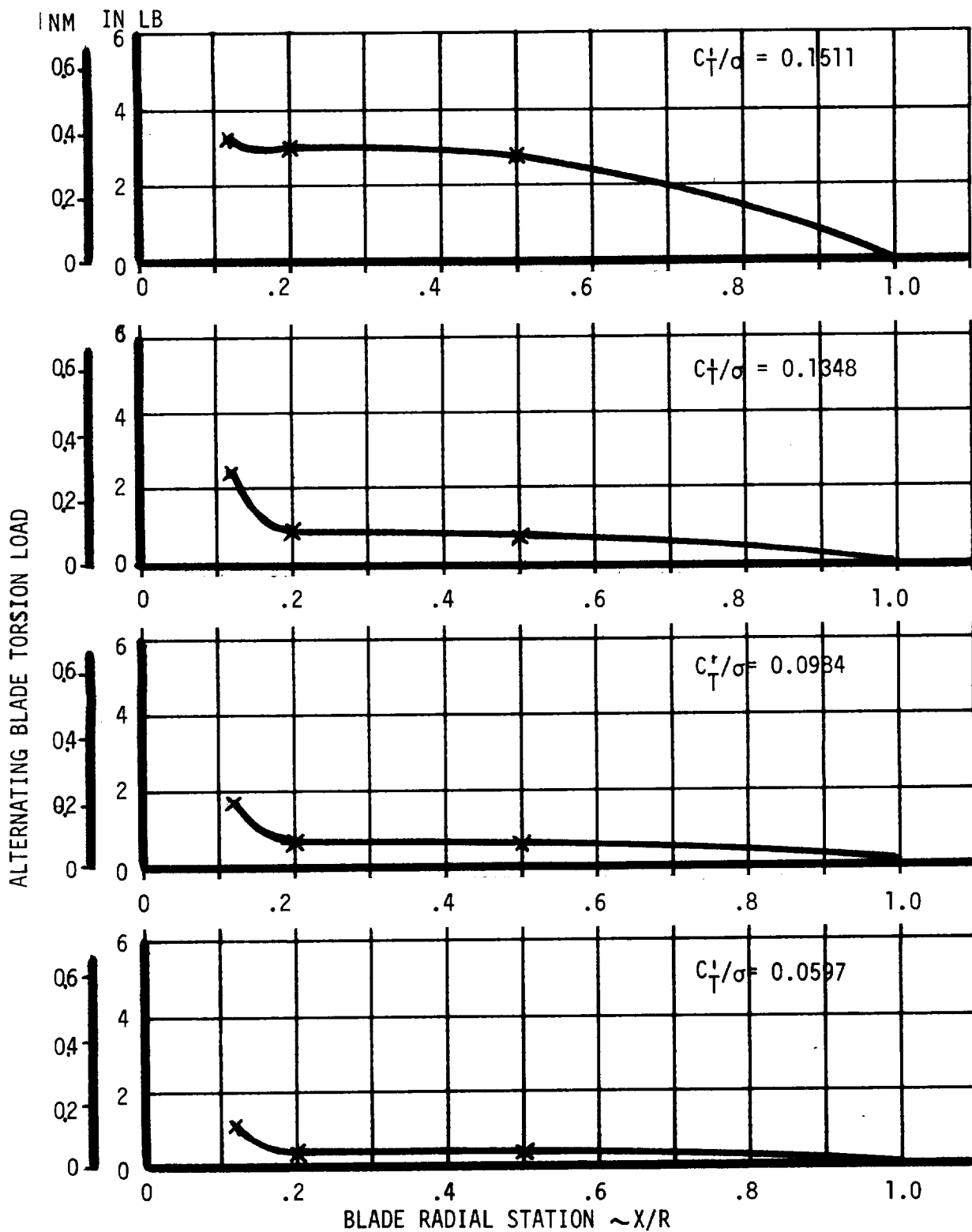


FIGURE 6.2.5 EFFECT OF ROTOR LIFT ON RADIAL DISTRIBUTION OF BLADE TORSION LOAD AT $\mu = 0$

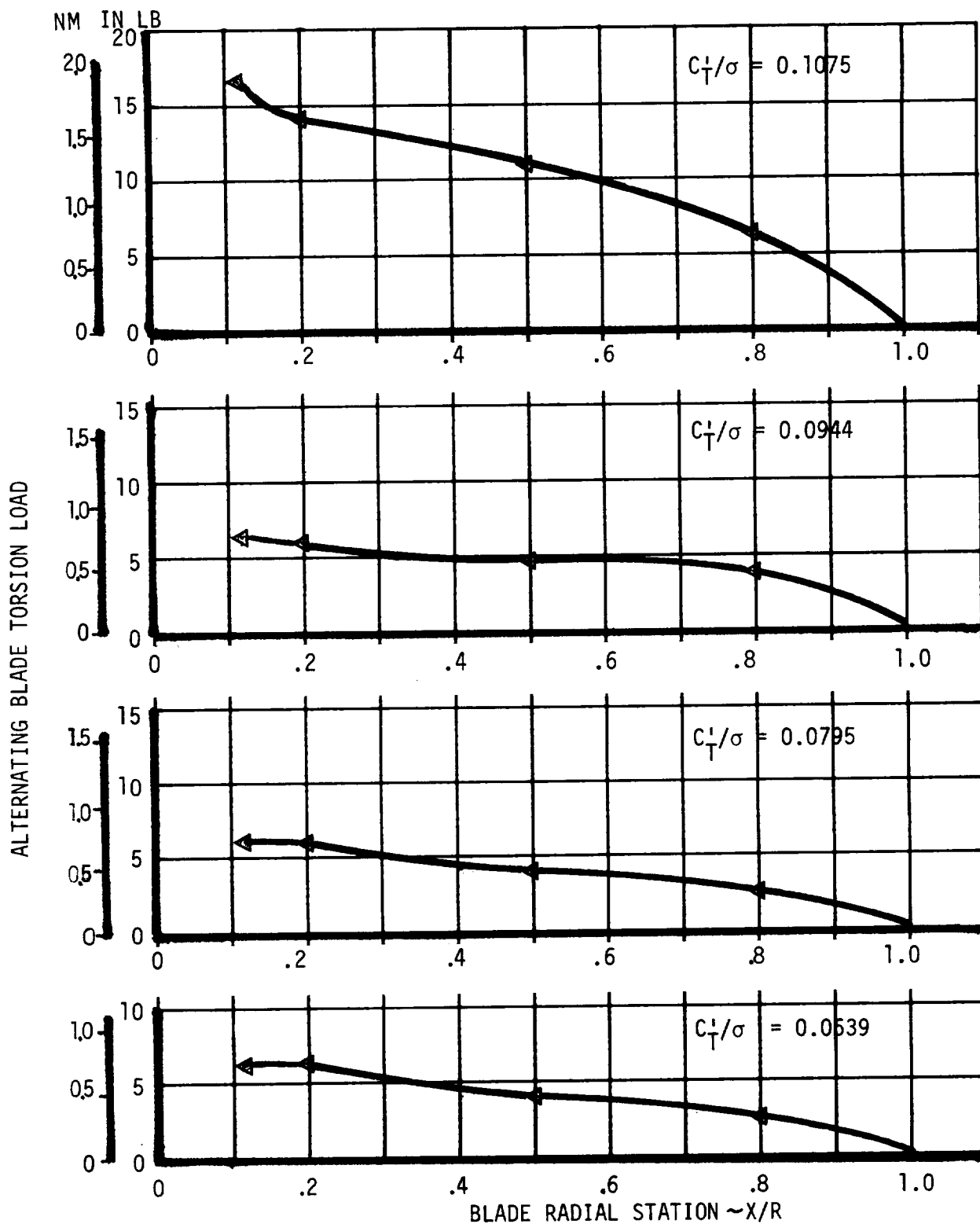


FIGURE 6.2.7 EFFECT OF ROTOR LIFT ON RADIAL DISTRIBUTION OF BLADE TORSION LOAD AT $\mu = 0.40$; $X/qd^2\sigma = 0.05$

1/10 SCALE CH47B ROTOR

$\mu = 0.0$
 $V_T = 620 \text{ FT/SEC}$
 189 M/SEC

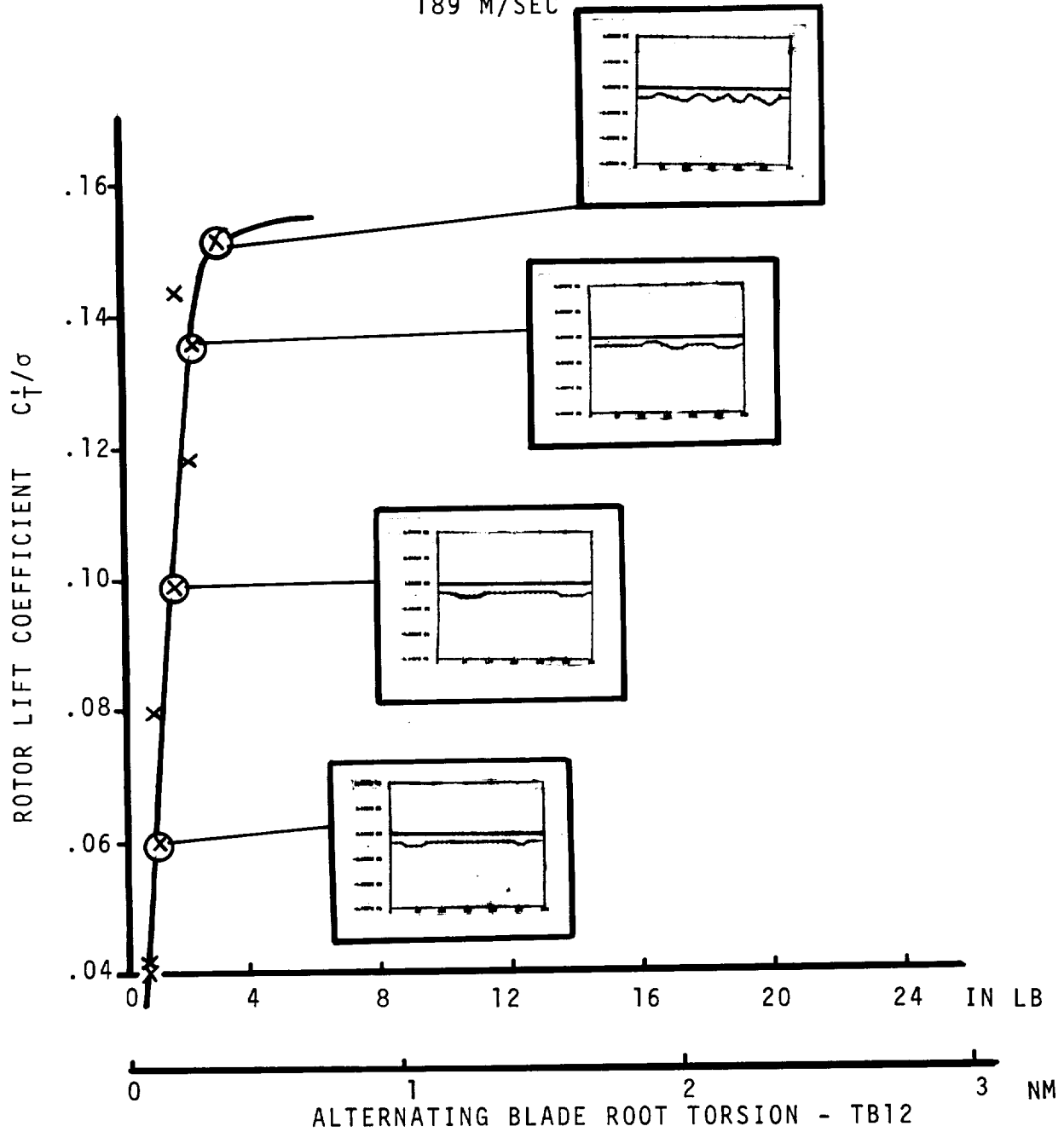


FIGURE 6.2.10 EFFECT OF APPROACHING THE LIFT LIMIT ON THE BLADE TORSION LOAD AT $\mu = 0$

1/10 SCALE CH47B ROTOR

$\mu = 0.40$

$V_T = 620 \text{ FT/SEC}$
 189 M/SEC

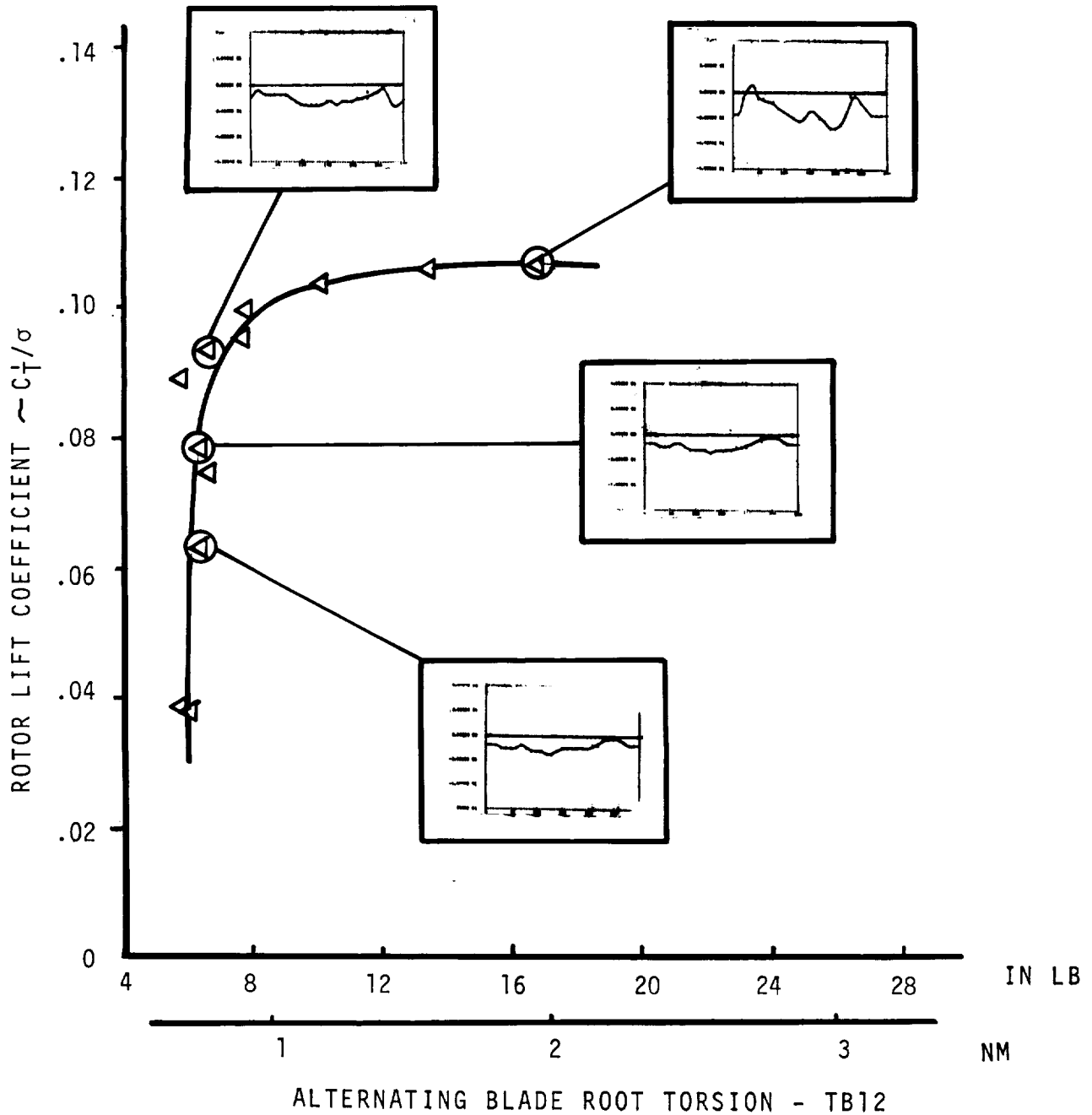


FIGURE 6.2.12 EFFECT OF APPROACHING LIFT LIMIT ON THE BLADE TORSION LOAD AT $\mu = 0.40$

1/10 SCALE CH47B ROTOR
 $\mu=0.57$

$V_T = 620 \text{ FT/SEC}$
 189 M/SEC

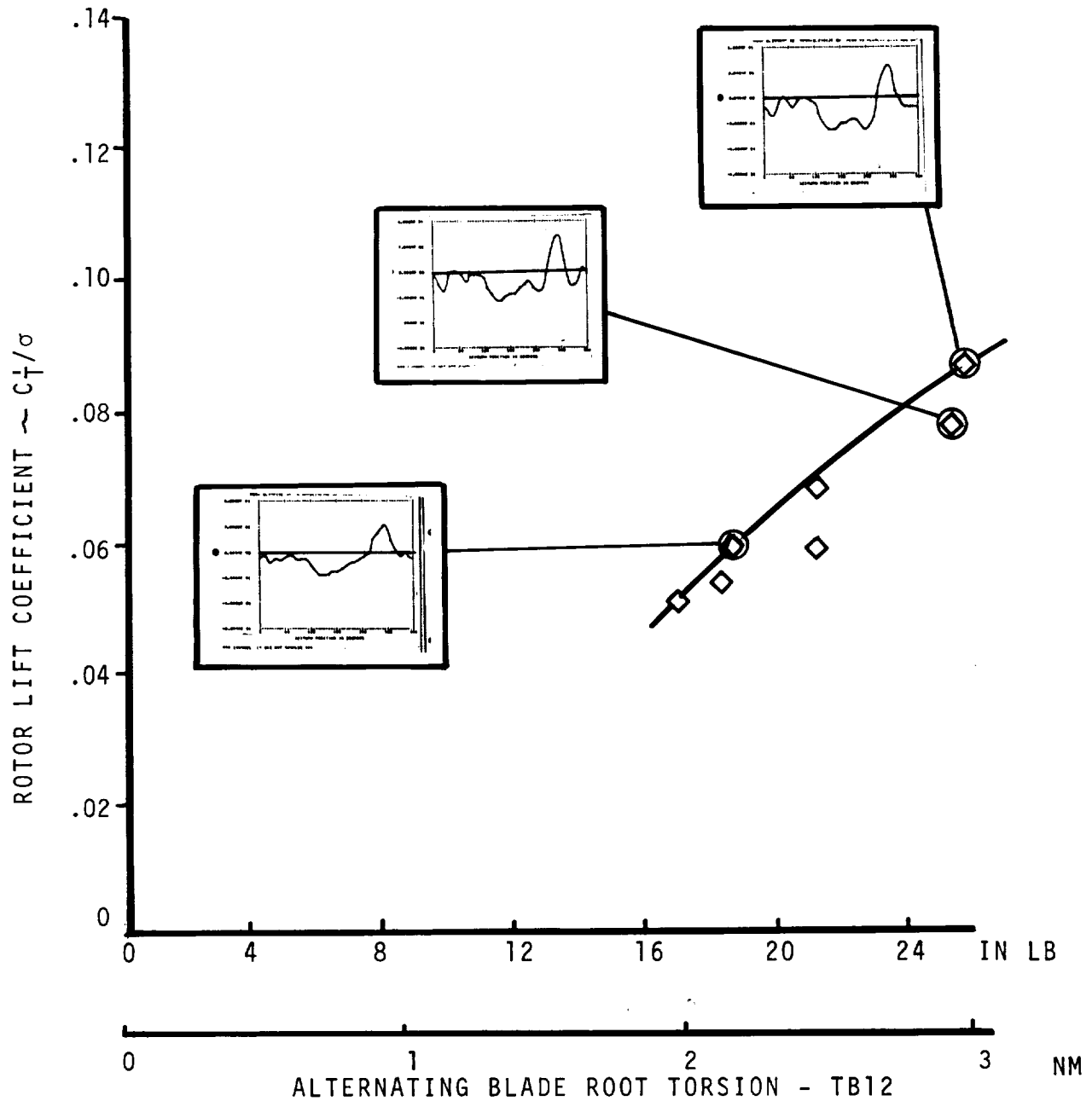
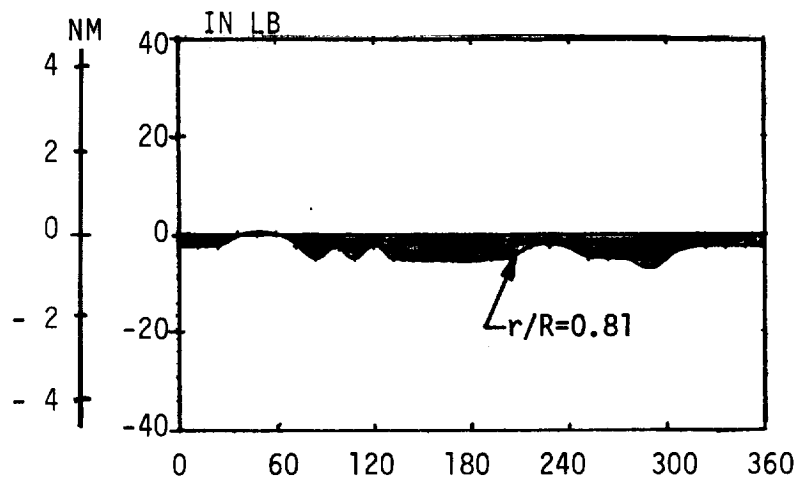
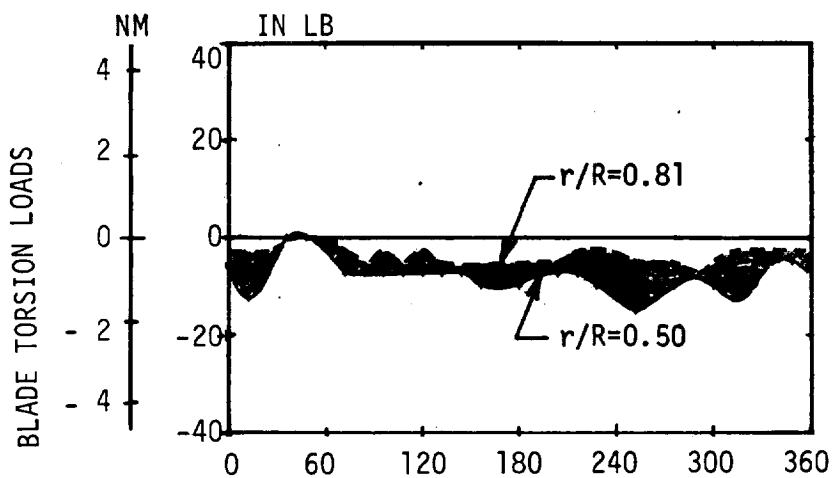


FIGURE 6.2.14 EFFECT OF APPROACHING THE LIFT LIMIT ON THE
 BLADE TORSION LOAD AT $\mu = 0.57$

OUTBOARD
TORSION
LOADS
 $r/R=0.81$
to 1.0



MID BLADE
TORSION
LOADS
 $r/R=0.50$
to 0.81



INBOARD
TORSION
LOADS
 $r/R=0.12$ to
0.50

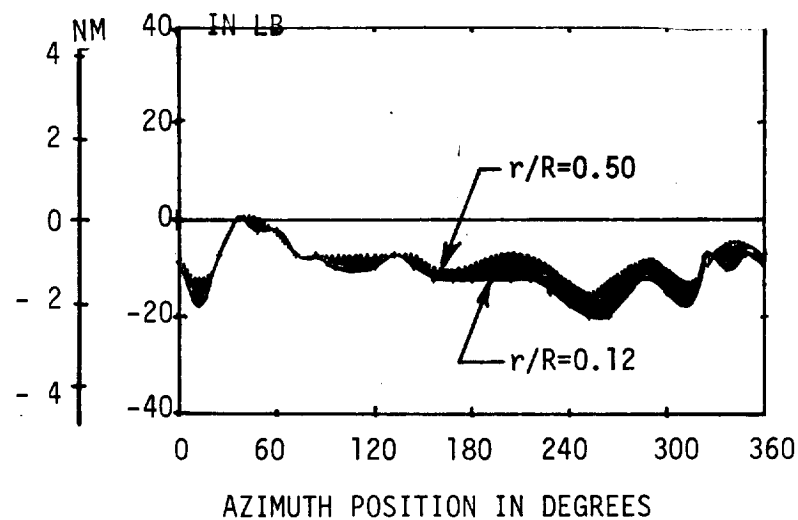
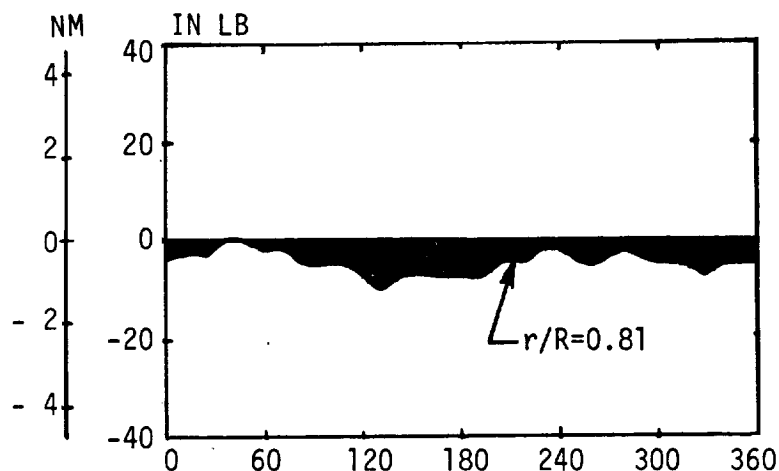
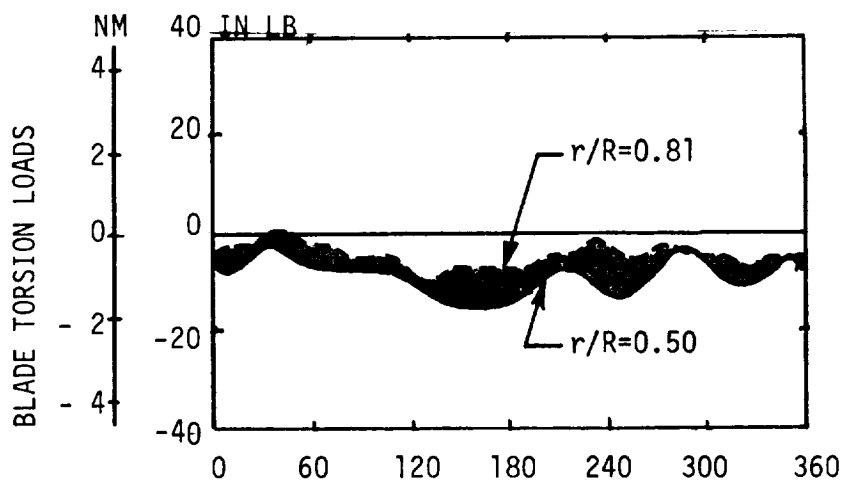


FIGURE 6.2.16 RADIAL AND AZIMUTHAL DISTRIBUTION OF BLADE TORSION LOADS,
 $\mu = 0.20$, $C_T^+/\sigma = 0.1333$, $X/qd^2\sigma = 0.05$

OUTBOARD
TORSION
LOADS
 $r/R=0.81$
to 1.0



MID BLADE
TORSION
LOADS
 $r/R=0.50$
to 0.81



INBOARD
TORSION
LOADS
 $r/R=0.12$
to 0.50

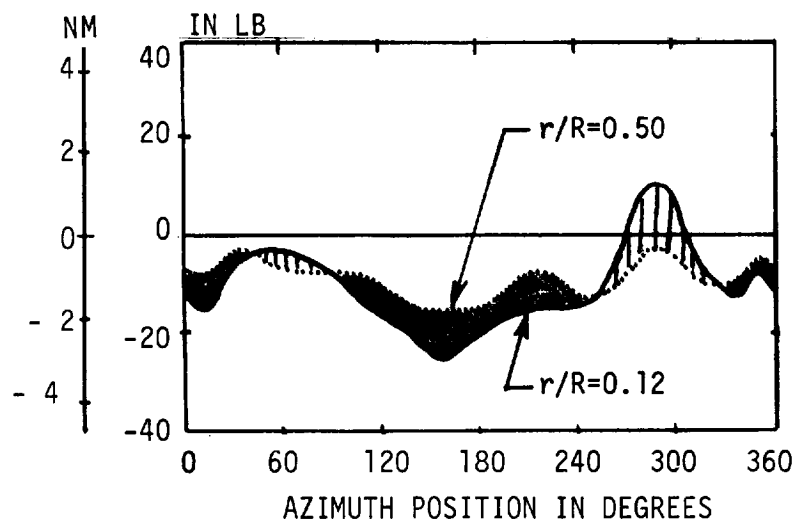


FIGURE 6.2.18 RADIAL AND AZIMUTHAL DISTRIBUTION OF BLADE TORSION LOADS,
 $\mu = 0.50$ $C_T'/\sigma = 0.1029$, $X/qd^2\sigma = 0.05$

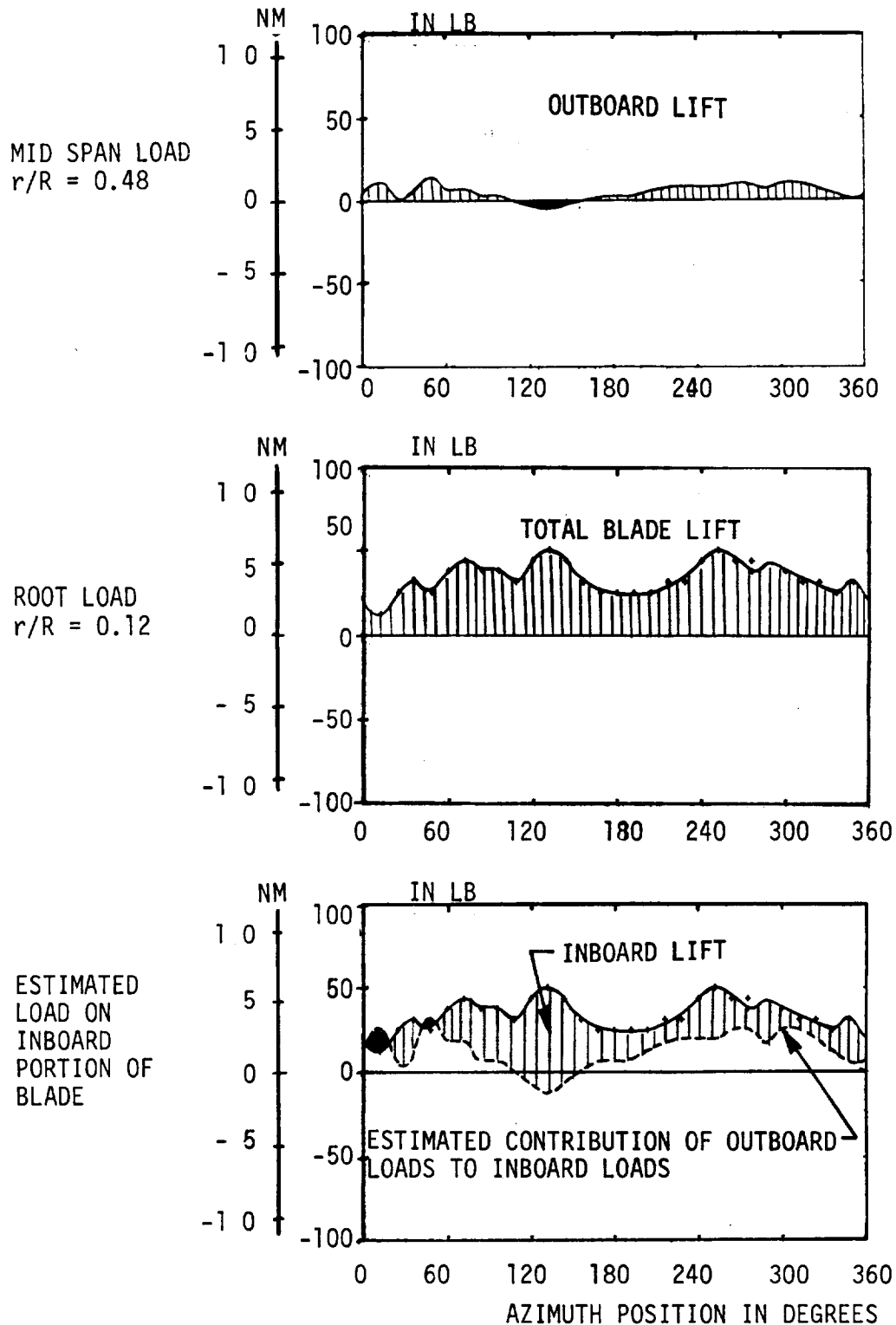


FIGURE 6.2.20 AZIMUTHAL VARIATION IN FLAP BENDING LOAD AND ESTIMATION OF MAJOR AREAS OF ROTOR LIFT $\mu = 0.20$, $C_T/\sigma = 0.1333$, $X/qd^2\sigma = 0.05$

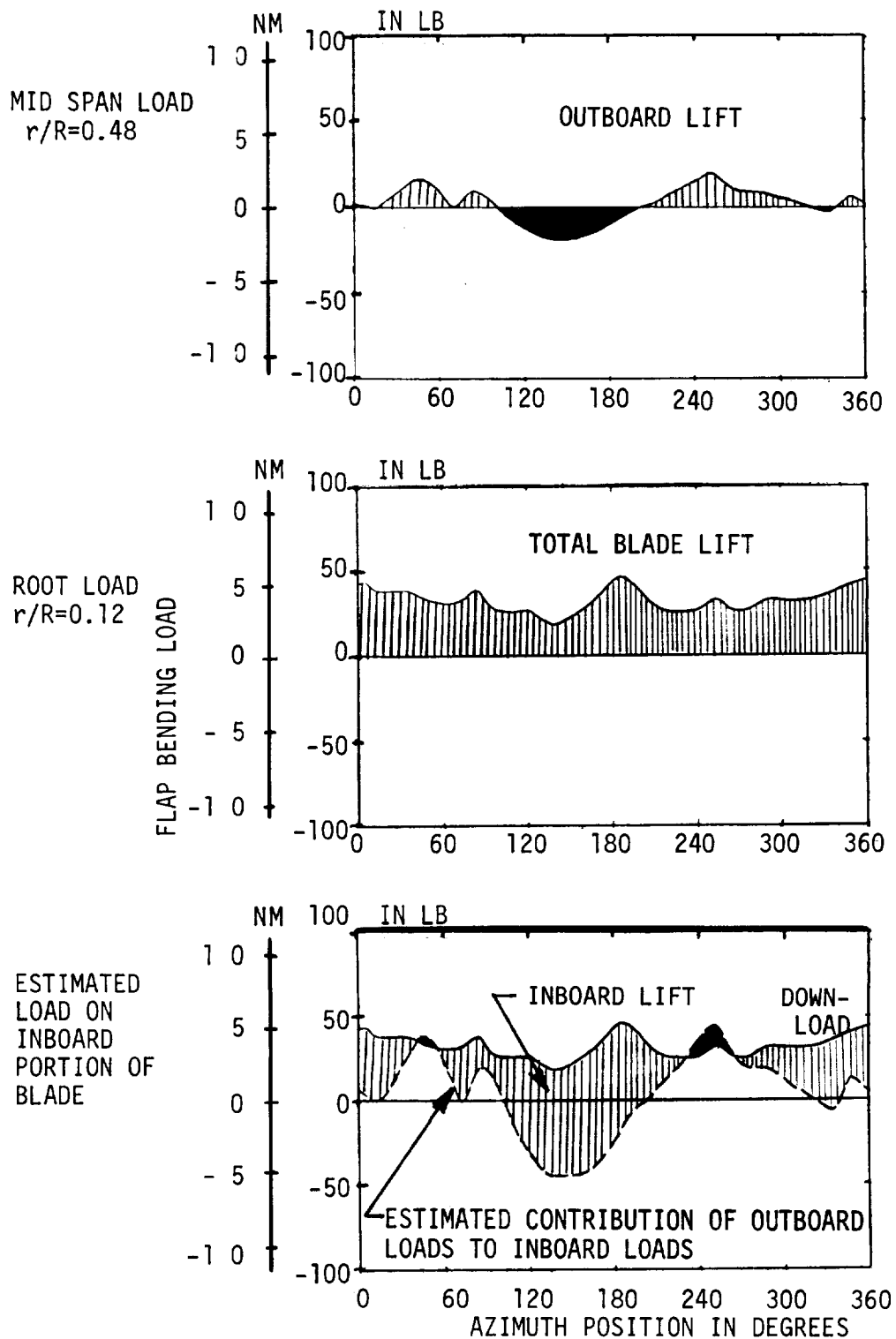


FIGURE 6.2.22 AZIMUTHAL VARIATION IN FLAP BENDING LOAD AND ESTIMATION OF MAJOR AREAS OF ROTOR LIFT - $\mu = 0.50$, $C_T/\sigma = 0.1029$, $X/qd^2\sigma = 0.05$

Figure 6.3.2 presents the performance data in terms of the rotor effective drag coefficient (C_{D_e}/σ) variation with rotor lift. There is a large improvement in rotor effective drag from an advance ratio of 0.10 to 0.20. A slight increase in effective drag coefficient is shown as the advance ratio is increased to $\mu = 0.40$. For advance ratios of 0.45, 0.50 and 0.53 the effective drag level is slightly increased over an advance ratio of 0.40 and they are all approximately the same. Increasing the advance ratio to 0.57 and then to 0.61 increases the effective drag reaching a level that is equal to that of an advance ratio of $\mu = 0.10$. The general trend evident for each of the advance ratios is that the effective drag starts to increase significantly at lift levels well below the lift limit, but in the lift level that is incurring inboard stall.

Rotor lift to effective drag ratio is a measure of cruise efficiency. The slope to any point on Figure 6.3.2 provides the L/D_E and the position of each advance ratio on this figure indicates their efficiency relative to each other. Maximum L/D_E indicated is 9.0 for an advance ratio of 0.20, decreases to 6.5 for $\mu = 0.40$ and then down to 1.8 at $\mu = 0.61$. A summary of the maximum rotor L/D_E is presented in Figure 6.3.3 indicating a peak value of 9.5 at $\mu = 0.28$. The trend from $\mu = 0.40$ to 0.61 resembles the lift limit trend showing a dip at an advance ratio of 0.45 and a lower peak of 4.5 at $\mu = 0.52$.

cyclic and lateral cyclic that correspond to the performance summary of Figure 6.3.1 are presented in Figures 6.3.4 through Figure 6.3.7. The other aspect of rotor performance is the capability of the rotor to accelerate from one steady state cruise condition to another and/or carry external loads. Performance data that addresses this was obtained during the propulsive force testing. At fixed levels of lift, the propulsive force was increased until a model physical limit was reached. This data is presented in Appendix B of Volume 2 and Figures 6.3.8 through Figure 6.3.10 are selected to present the performance data obtained at three advance ratios. Figure 6.3.8 shows the variation in rotor power coefficient with the increasing propulsive force requirements at $\mu = 0.40$. The two data trends are for 80 percent and 60 percent of the maximum lift limit when $X/qd^2\sigma = 0.05$. The resulting trends are linear with a slight decrease in slope as the lift is increased. A linear variation indicates a fixed effectiveness of the rotor for converting power to propulsive force and is defined as rotor propulsive efficiency (η_p). A rotor propulsive efficiency of 100% is the ideal conversion of power to propulsive force.

$$\eta_p = \frac{\Delta(X)}{\Delta(P/V)}$$

$$\text{Ideal } \eta_p = 100\%$$

$$\frac{\Delta P}{V} = \Delta X$$

understand the differences in performance resulting at the higher levels of lift and at $\mu = 0.53$ and 0.57 . These differences are also reflected in the lift limits that are discussed in Section 6.5.

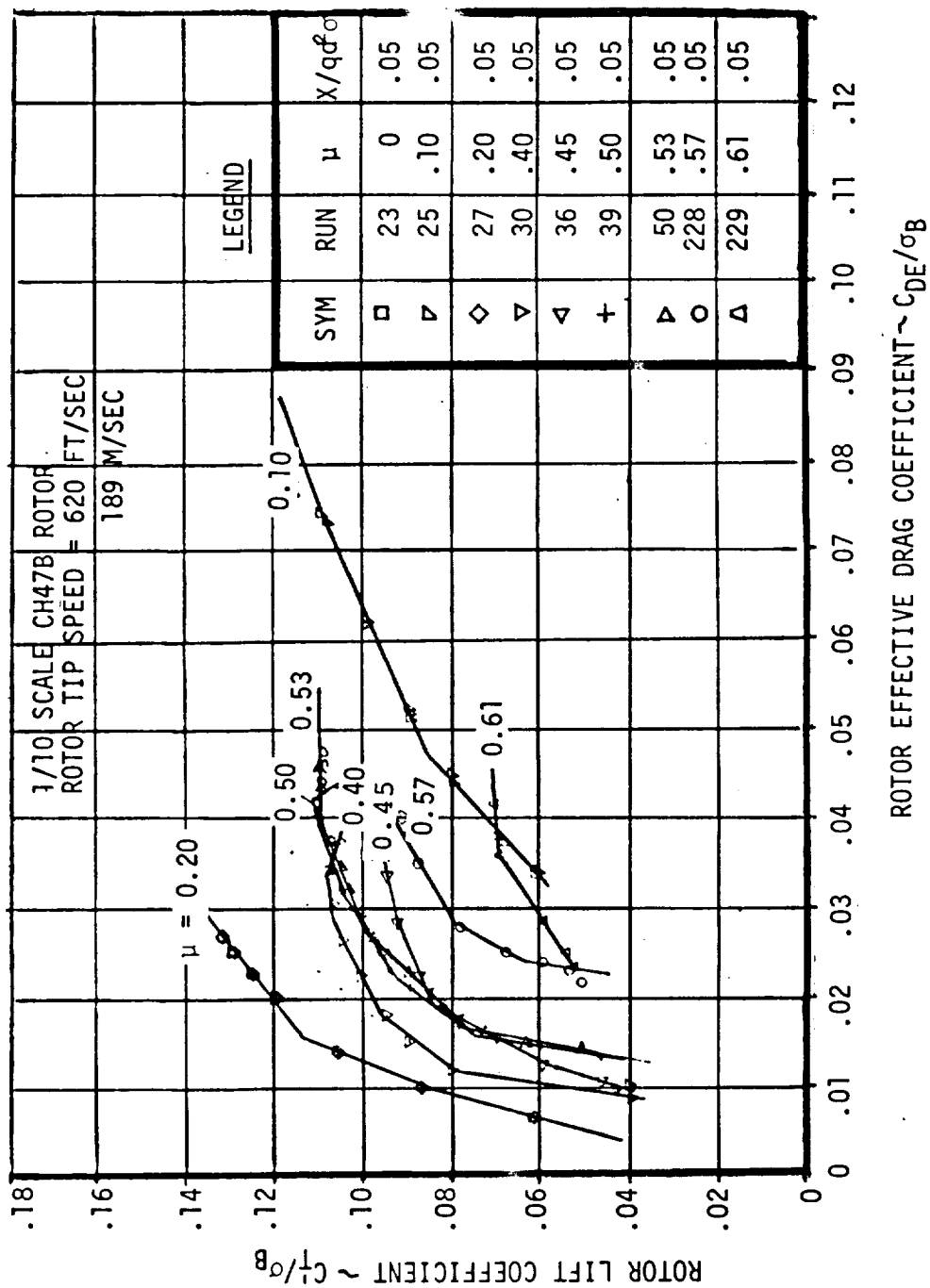


FIGURE 6.3.2 ROTOR EFFECTIVE DRAG FOR PERFORMANCE SUMMARY $V_T = 620$ FT/SEC

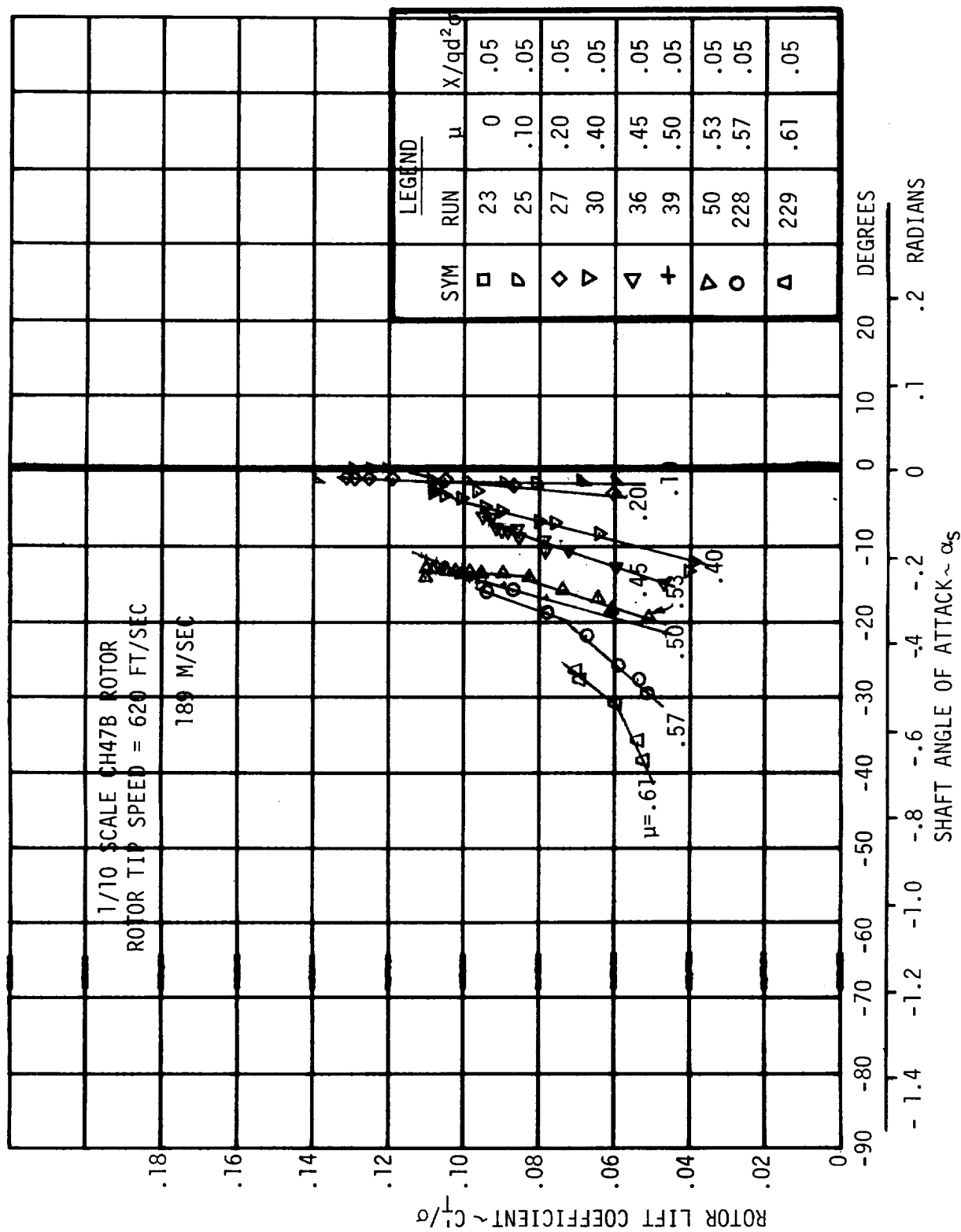


FIGURE 6.3.4 SHAFT ANGLE OF ATTACK FOR PERFORMANCE SUMMARY $V_T = 620$ FT/SEC

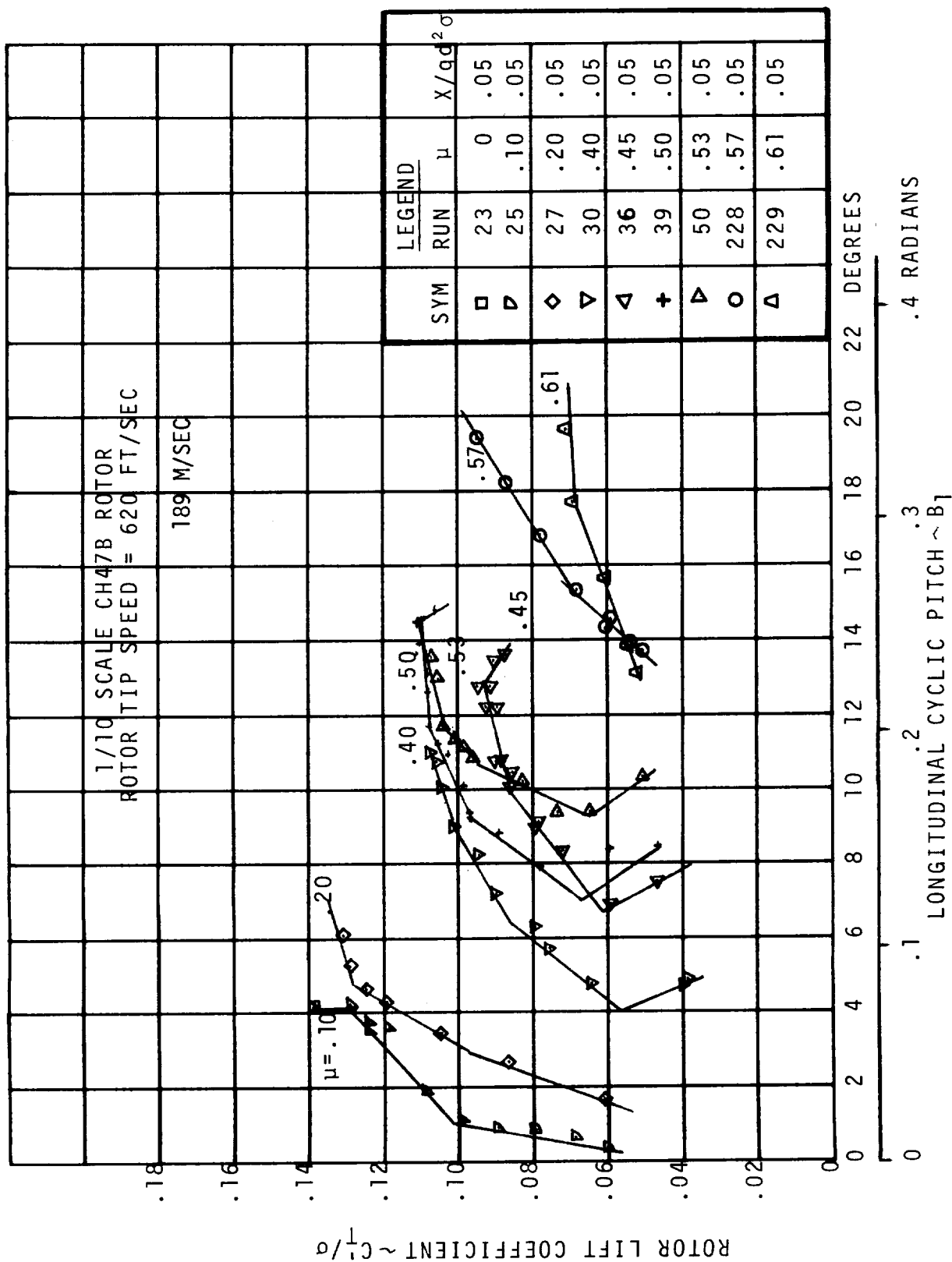


FIGURE 5.3.6 LONGITUDINAL CYCLIC PITCH FOR PERFORMANCE SUMMARY $V_T = 620$ FT/SEC

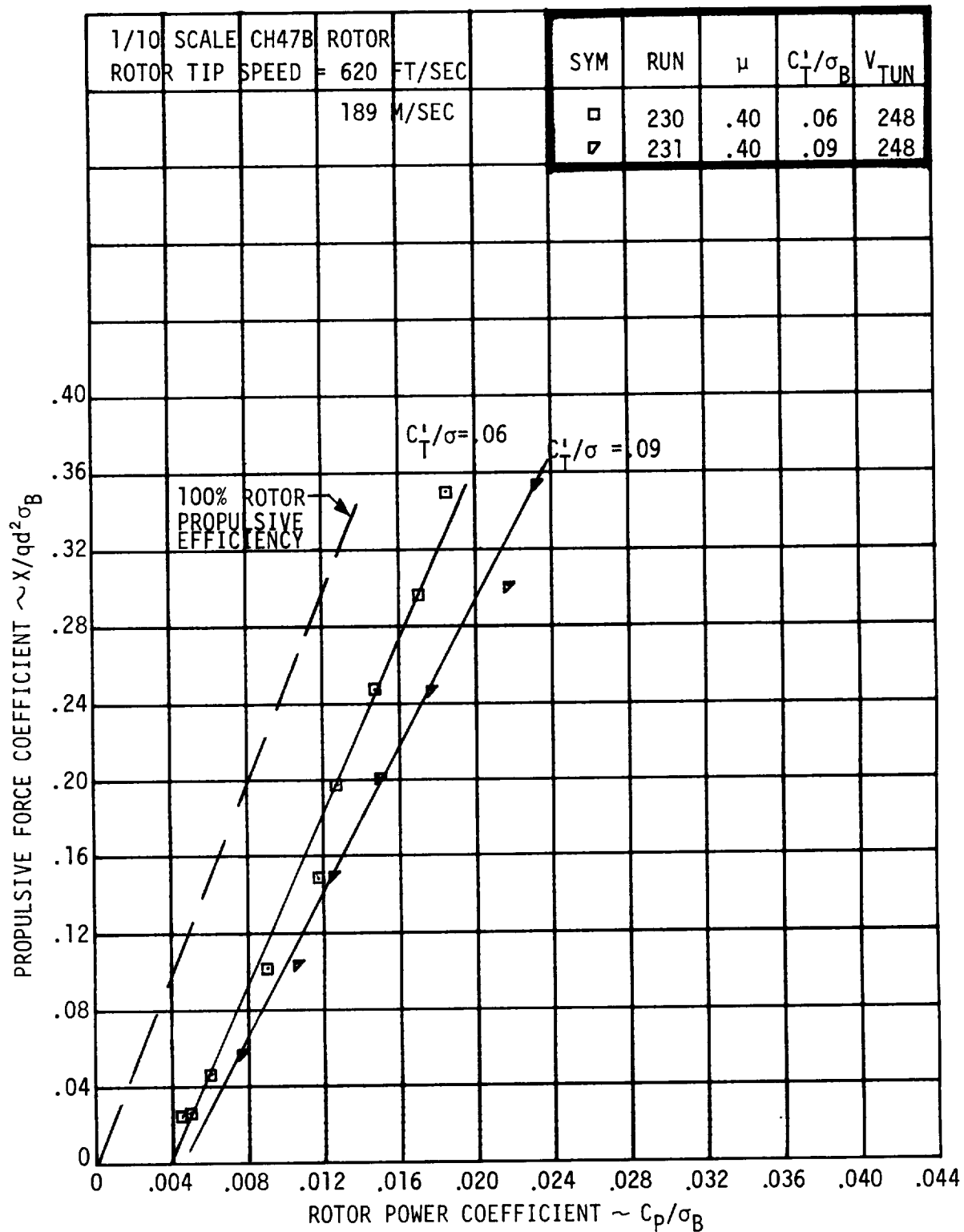


FIGURE 6.3.8 EFFECT OF PROPULSIVE FORCE ON ROTOR POWER REQUIRED
AT CONSTANT LIFT, $\mu = 0.40$

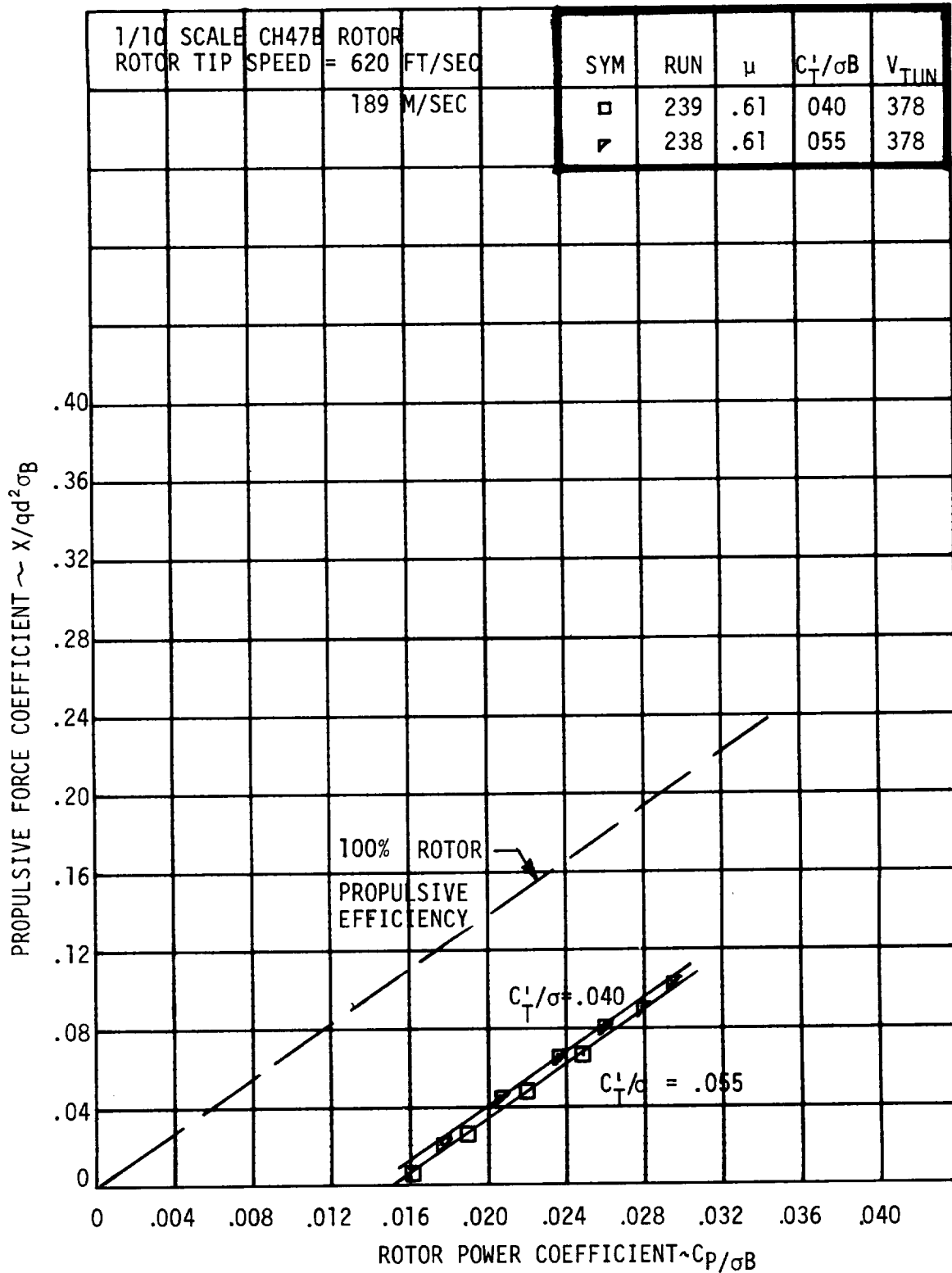


FIGURE 6.3.10 EFFECT OF PROPULSIVE FORCE ON ROTOR POWER REQUIRED AT CONSTANT LIFT, $\mu = 0.61$

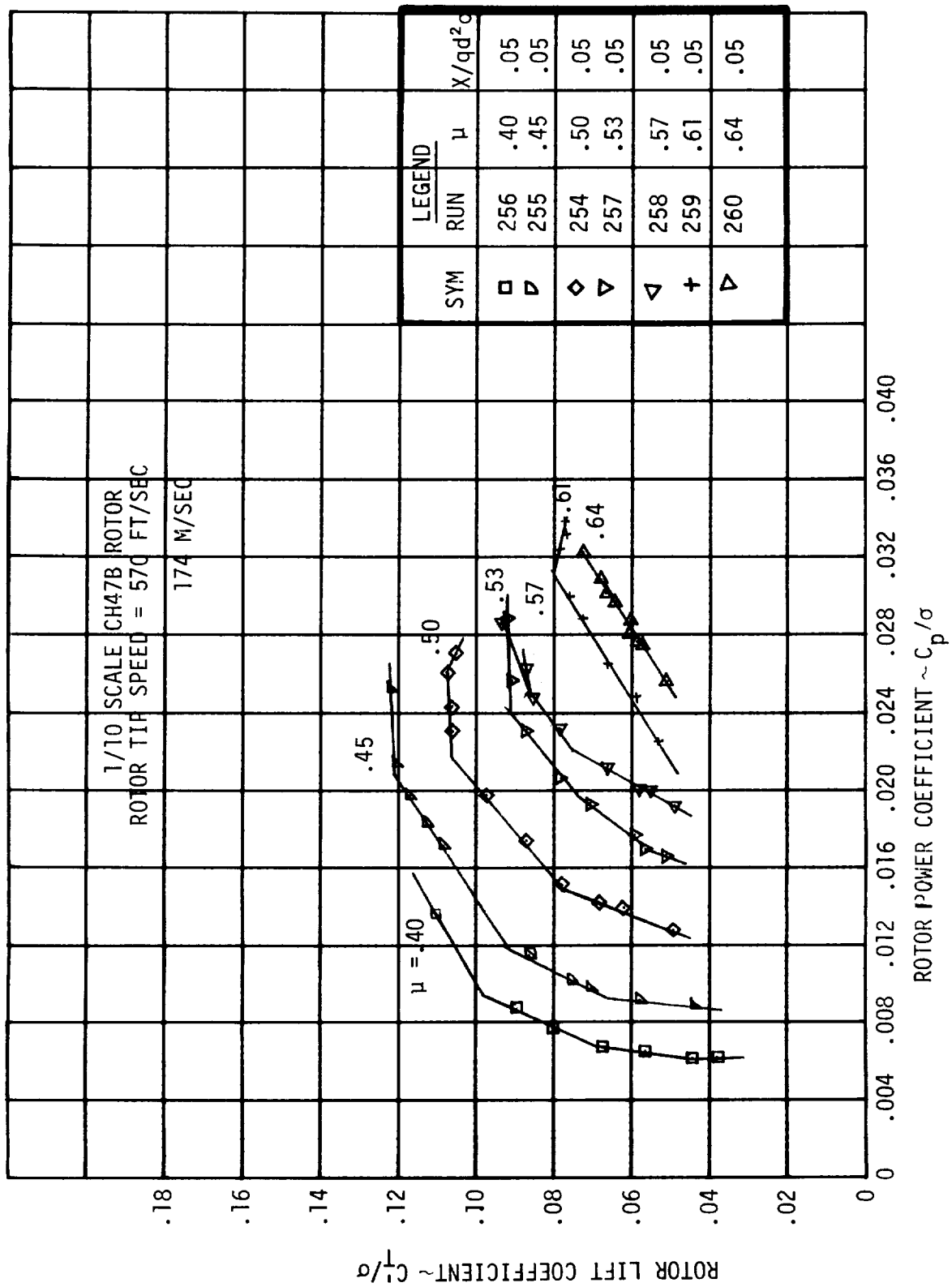


FIGURE 6.3.12 ROTOR PERFORMANCE SUMMARY AT $V_T = 570$ FT/SEC

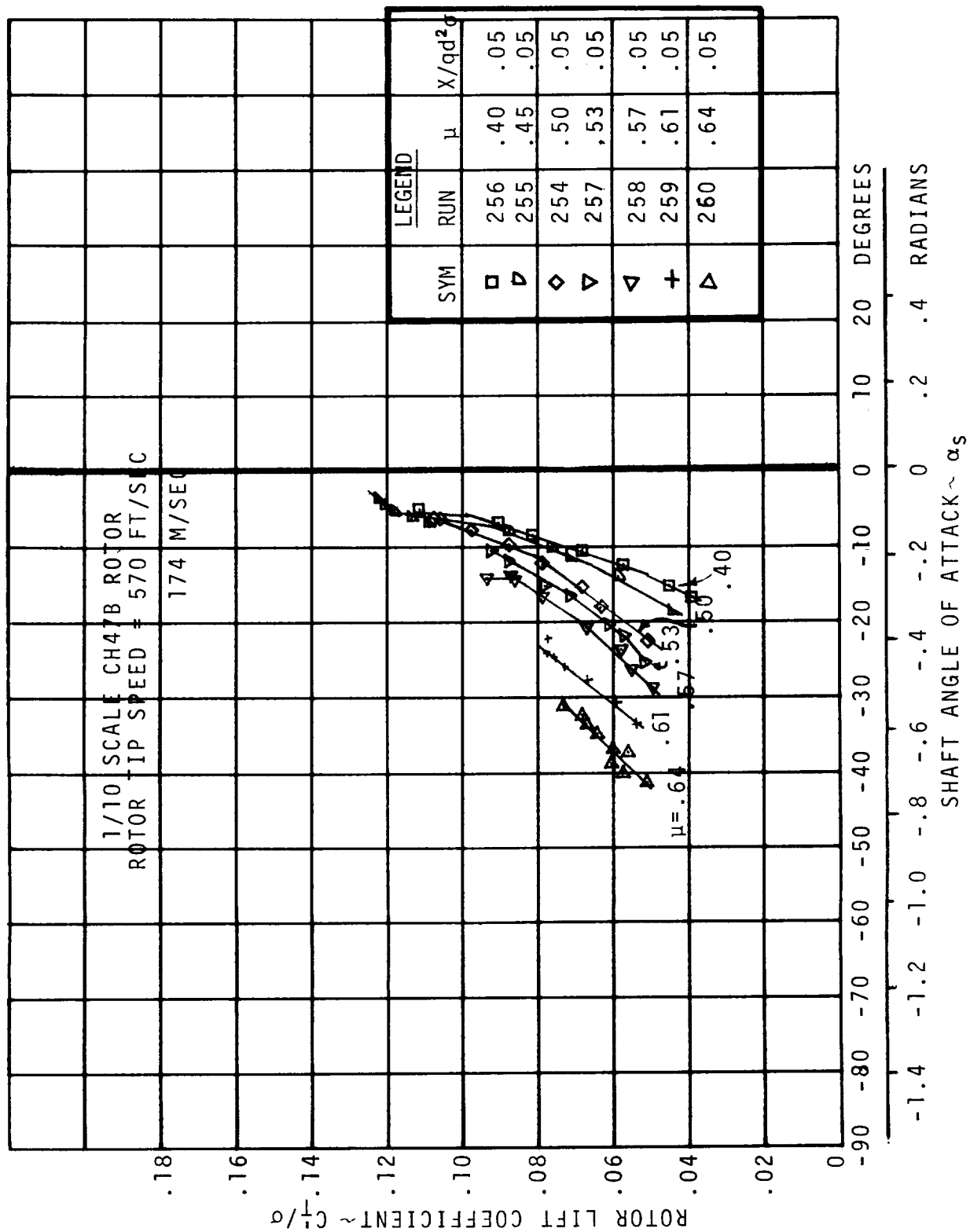


FIGURE 6.3.14 SHAFT ANGLE OF ATTACK FOR PERFORMANCE SUMMARY $V_T = 570$ FT/SEC

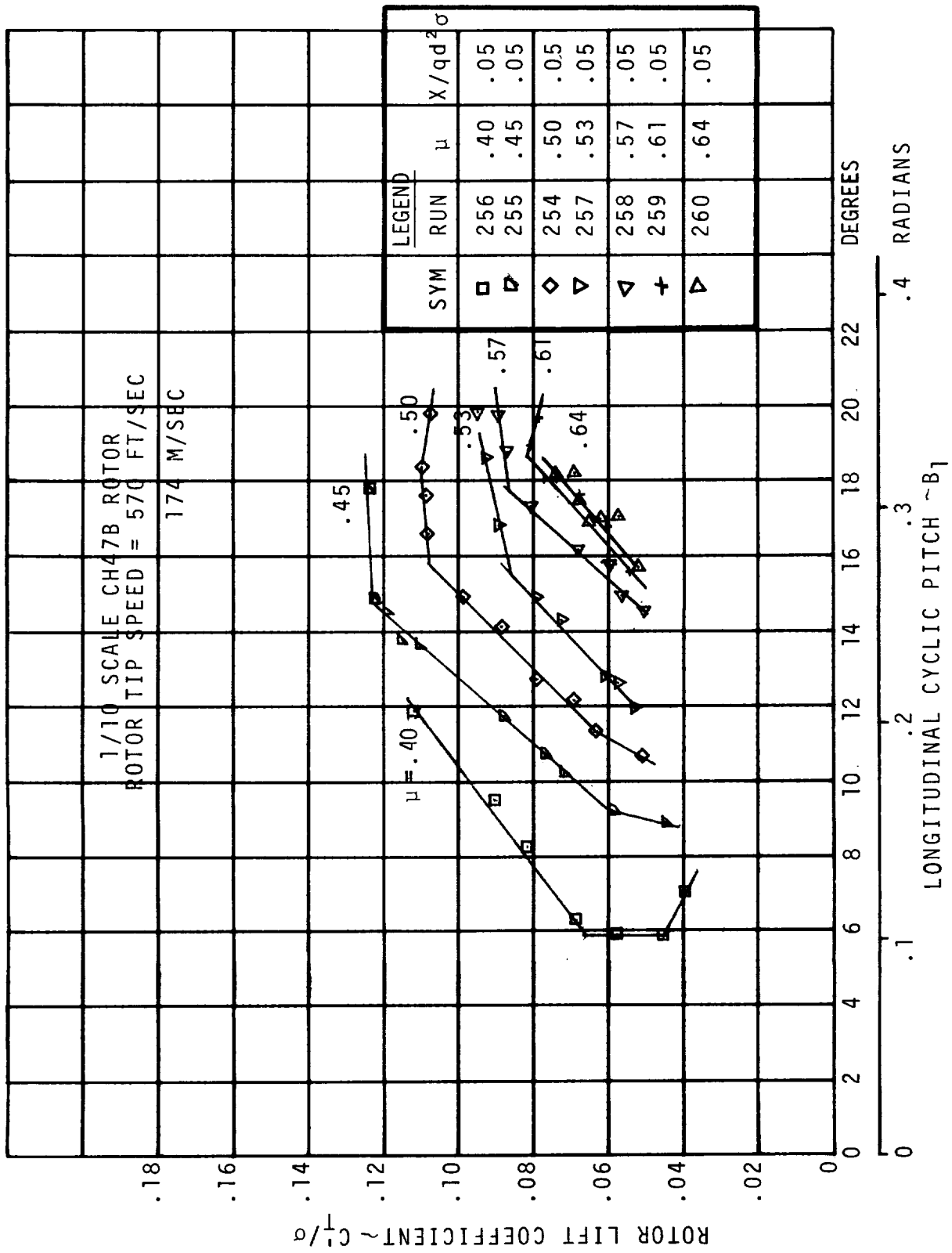


FIGURE 6.3.16 LONGITUDINAL CYCLIC PITCH FOR PERFORMANCE SUMMARY $V_T = 570$ FT/SEC

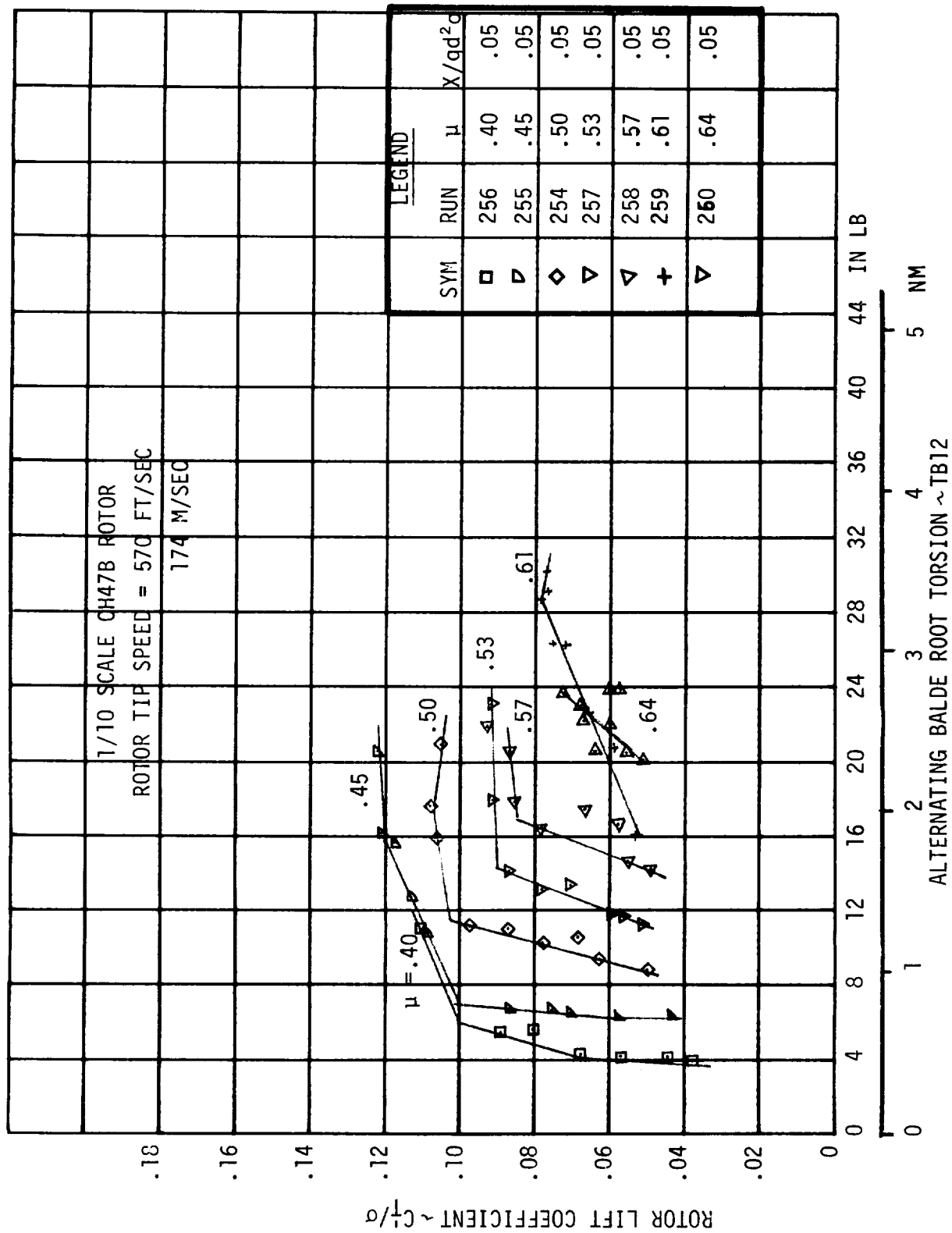


FIGURE 6.3.18 ALTERNATING BLADE ROOT TORSION LOADS FOR PERFORMANCE SUMMARY AT $V_T = 570$ FT/SEC

longitudinal force indicate no change in sensitivity when operating near the lift limit. Rotor thrust and power variations with longitudinal or lateral cyclic are unaffected as the rotor lift is increased from 70 percent to 90 percent of the lift limit at an advance ratio of 0.20, as indicated in Figure 6.4.3.

For an advance ratio of 0.40, the sensitivity of rotor hub moments and inplane forces to longitudinal cyclic are presented in Figure 6.4.4 and to lateral cyclic in Figure 6.4.5. There is no change in any of the sensitivities as a result of operating near stall. The impact of longitudinal or lateral cyclic on rotor thrust and power is presented in Figure 6.4.6 and indicates no change results from operating at the higher lift level.

When increasing the operating speed up to an advance ratio of 0.53 the sensitivity of rotor pitching moment and longitudinal force are slightly increased when operating near the lift limit as shown in Figure 6.4.7. The sensitivities become slightly greater in the cross coupling terms of rotor rolling moment and side force when operating near stall. The lateral control characteristics of Figure 6.4.8 are less affected by operation near stall than the longitudinal control characteristics. At $\mu = 0.53$ there was no effect on the thrust or power sensitivities to longitudinal or lateral cyclic. The conclusion drawn from these data trends is that there is a negligible effect on the control power resulting from operation at 90 percent of the lift limit at all speeds up to an advance ratio of 0.53.

189 M/SEC

C. Basic Test Data from Control Power Testing

As indicated in Section 5, of the main report, the control power testing was conducted concurrently with the lift limit testing at fixed levels of propulsive force. The control power characteristics are defined by the changes in rotor forces and moments produced by increasing or decreasing the cyclic pitch from a trimmed flight condition at 90 percent and 70 percent of the maximum lift achieved at that specific advance ratio and propulsive force level. This was repeated at each propulsive force level and advance ratio for the basic rotor tip speed of 620 ft/sec.

Test data obtained from each of the test runs has been combined to show the impact of advance ratio, propulsive force level, and stall proximity on the control power characteristics. The combinations, identified as plot sets, are defined in Table C-1 and are marked on the bottom of each sheet. Within each plot set are a series of graphs presenting the variation of each component of measured data with lateral cyclic or longitudinal cyclic noting the base point or trimmed flight condition. An example of the sequence of these graphs is presented below for lateral cyclic and the sequence will be the same for longitudinal cyclic.

Rotor Lift Coefficient versus Lateral Cyclic

Rotor Propulsive Force Coefficient versus Lateral Cyclic

Rotor Power Coefficient versus Lateral Cyclic

Rotor Pitching Moment Coefficient versus Lateral Cyclic

Rotor Rolling Moment Coefficient versus Lateral Cyclic

Rotor Longitudinal Force Coefficient versus Lateral Cyclic
Rotor Side Force Coefficient versus Lateral Cyclic
Alternating Root Flap Bending FB12 versus Lateral Cyclic
Alternating Root Chord Bending CB12 versus Lateral Cyclic
Alternating Root Torsion TB12 versus Lateral Cyclic

TABLE C-1 DATA PLOTTING SUMMARY FOR THE CONTROL POWER TESTING

PLOT SET	RUN NO.	ROTOR TIP SPEED V_T	ADVANCE RATIO μ	ROTOR LIFT COEFF. G_L/σ	ROTOR PROPULSIVE FORCE COEFF. $X/qd^2\sigma$	TUNNEL SPEED V	COMMENTS
8	25	620FPS	.1	.124	.05	62FPS	Control power in cruise lateral
	28	620FPS	.2	.123	.05	124FPS	
	29	620FPS	.3	.098	.05	186FPS	
	30	620FPS	.4	.095	.05	248FPS	
9	28	620FPS	.2	.123	.05	124FPS	lateral
	28	620FPS	.2	.090	.05	124FPS	
10	30	620FPS	.4	.095	.05	248FPS	lateral
	30	620FPS	.4	.076	.05	248FPS	
11	25	620FPS	.10	.124	.05	62FPS	longitudinal
	28	620FPS	.20	.123	.05	124FPS	
	30	620FPS	.40	.095	.05	248FPS	
12	28	620FPS	.20	.123	.05	124FPS	longitudinal
	28	620FPS	.20	.090	.05	124FPS	
13	30	620FPS	.40	.095	.05	248FPS	longitudinal
	30	620FPS	.40	.076	.05	248FPS	
14	32	620FPS	.40	.100	.01	248FPS	lateral
	30	620FPS	.40	.095	.05	248FPS	
	33	620FPS	.40	.088	.10	248FPS	

TABLE C-1 DATA PLOTTING SUMMARY FOR THE CONTROL POWER SETTING
(Continued)

PLOT SET	RUN NO.	ROTOR TIP SPEED V_T	ADVANCE RATIO μ	ROTOR LIFT COEFF. G_L/σ	ROTOR PROPULSIVE FORCE COEFF. $X/qd^2\sigma$	TUNNEL SPEED V	COMMENTS
15	32	620FPS	.40	.077	.01	248FPS	lateral
	30	620FPS	.40	.076	.05	248FPS	
	33	620FPS	.40	.070	.10	248FPS	
16	32	620FPS	.40	.100	.01	248FPS	lateral
	32	620FPS	.40	.077	.01	248FPS	
17	33	620FPS	.40	.088	.10	248FPS	lateral
	33	620FPS	.40	.070	.10	248FPS	
18	32	620FPS	.40	.100	.01	248FPS	longitudinal
	30	620FPS	.40	.095	.05	248FPS	
	33	620FPS	.40	.088	.10	248FPS	
19	32	620FPS	.40	.076	.01	248FPS	longitudinal
	30	620FPS	.40	.076	.05	248FPS	
	33	620FPS	.40	.070	.10	248FPS	
20	32	620FPS	.40	.100	.01	248FPS	longitudinal
	32	620FPS	.40	.76	.01	248FPS	
21	33	620FPS	.40	.088	.10	248FPS	longitudinal
	33	620FPS	.40	.070	.10	248FPS	
22	39	620FPS	.50	.098	.05	310FPS	Control power in cruise
	41	620FPS	.50	.090	.10	310FPS	lateral
	42	620FPS	.50	.073	.20	310FPS	

TABLE C-1 DATA PLOTTING SUMMARY FOR THE CONTROL POWER SETTING
(CONTINUED)

PLOT SET	RUN NO.	ROTOR TIP SPEED V_T	ADVANCE RATIO μ	ROTOR LIFT COEFF. G_L/σ	ROTOR PROPULSIVE FORCE COEFF. $X/qd^2\sigma$	TUNNEL SPEED V	COMMENTS
23	39	620FPS	.50	.078	.05	310FPS	lateral
	41	620FPS	.50	.069	.10	310FPS	
	42	620FPS	.50	.059	.20	310FPS	
24	39	620FPS	.50	.098	.05	310FPS	lateral
	39	620FPS	.50	.078	.05	310FPS	
25	41	620FPS	.50	.090	.10	310FPS	lateral
	41	620FPS	.50	.069	.10	310FPS	
26	43	620FPS	.50	.073	.20	310FPS	lateral
	43	620FPS	.50	.059	.20	310FPS	
27	39	620FPS	.50	.098	.05	310FPS	longitudinal
	41	620FPS	.50	.090	.10	310FPS	
	42	620FPS	.50	.073	.20	310FPS	
28	39	620FPS	.50	.078	.05	310FPS	longitudinal
	41	620FPS	.50	.069	.10	310FPS	
	42	620FPS	.50	.059	.20	310FPS	
29	39	620FPS	.50	.098	.05	310FPS	longitudinal
	39	620FPS	.50	.078	.05	310FPS	
30	41	620FPS	.50	.090	.10	310FPS	longitudinal
	41	620FPS	.50	.069	.10	310FPS	

TABLE C-1 DATA PLOTTING SUMMARY FOR THE CONTROL POWER SETTING
(CONTINUED)

PLOT SET	RUN NO.	ROTOR TIP SPEED V_T	ADVANCE RATIO μ	ROTOR LIFT COEFF. G_T/σ	ROTOR PROPULSIVE FORCE COEFF. $X/qd^2\sigma$	TUNNEL SPEED V	COMMENTS
31	42	620FPS	.50	.073	.20	310FPS	longitudinal
	42	620FPS	.50	.059	.20	310FPS	
32	50	620FPS	.53	.102	.05	329FPS	lateral
	50	620FPS	.53	.079	.05	329FPS	
33	50	620FPS	.53	.102	.05	329FPS	longitudinal
	50	620FPS	.53	.079	.05	329FPS	

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Figure C-1

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-42B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT'/SB	VTUN	$\Delta C_T' / \Delta A_1$
□	25	.1	.05	.124	62	+.00030
△	28	.2	.05	.123	124	-.00030
◇	29	.3	.05	.098	186	-.00030
▽	30	.4	.05	.095	248	-.00030

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC

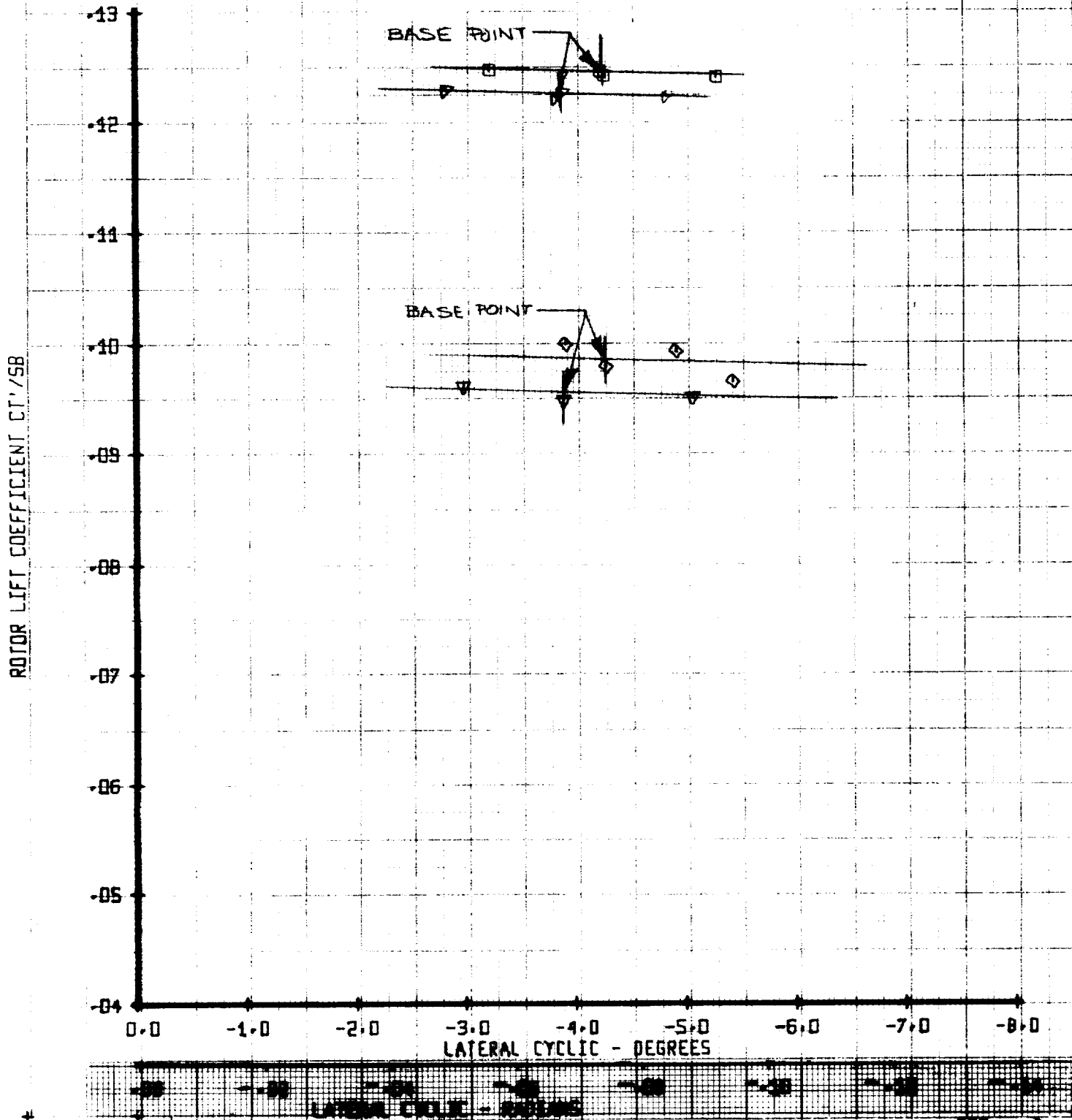


Figure C-2

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	25	.1	.05	.124	62
△	28	.2	.05	.123	124
◇	29	.3	.05	.099	196
▽	30	.4	.05	.095	249

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

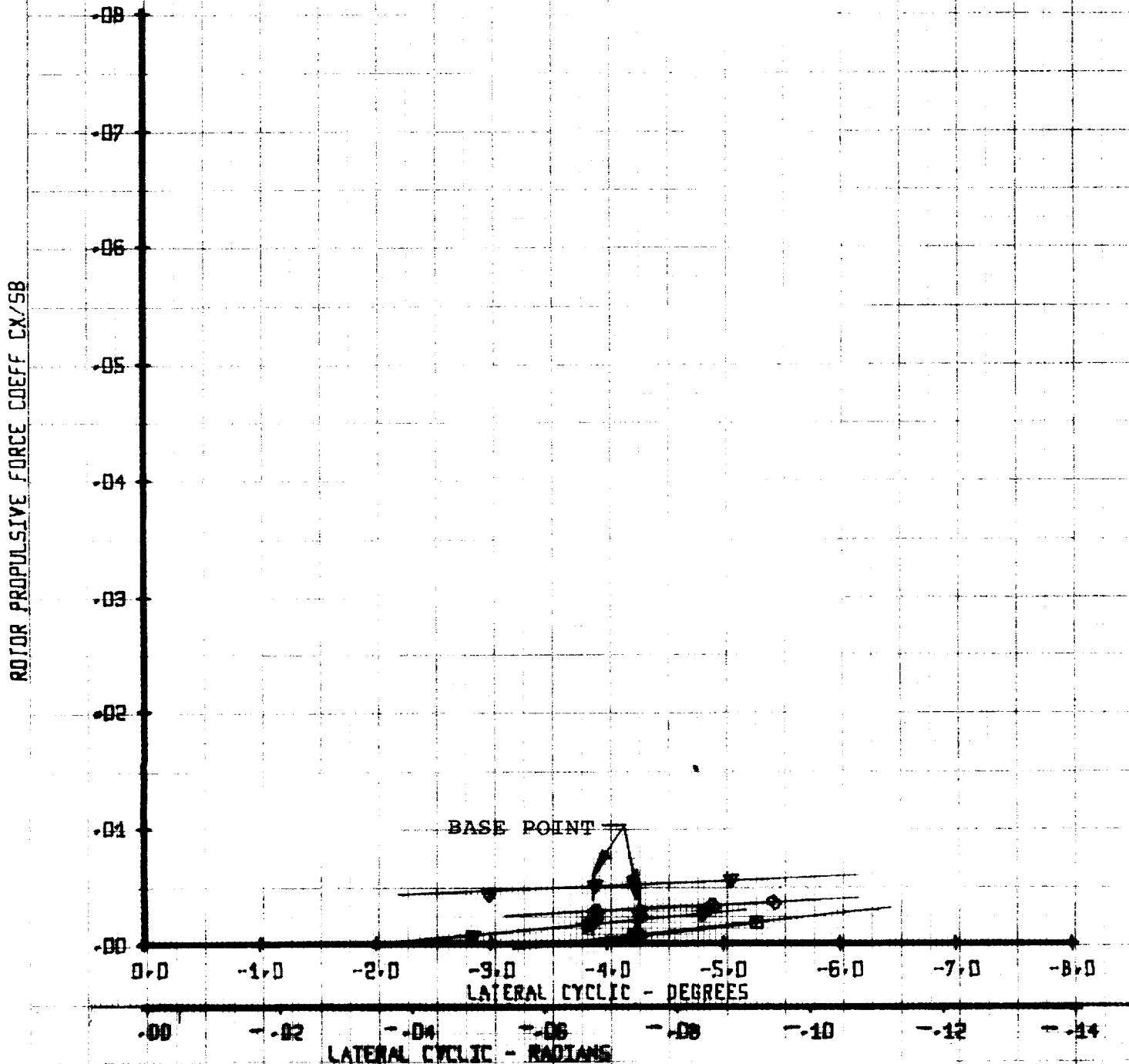


Figure C-3

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT/5B	VTUN
○	25	.1	.05	.124	62
△	28	.2	.05	.123	124
◇	29	.3	.05	.098	186
▽	30	.4	.05	.095	248

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

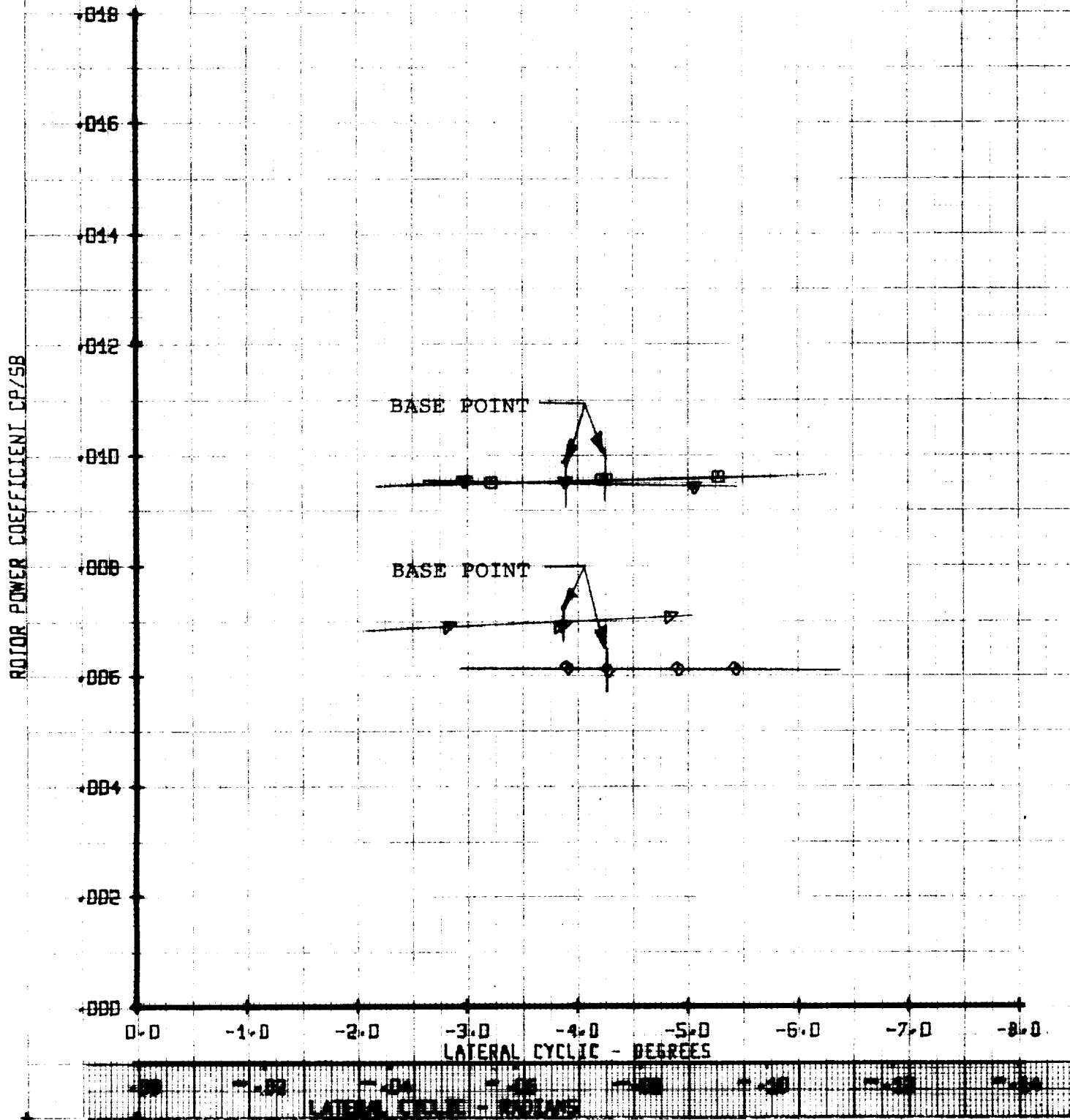


Figure C-4

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/OD2SB	CT'/SB	VTUN
□	25	.1	.05	.124	62
△	28	.2	.05	.123	124
◇	29	.3	.05	.098	186
▽	30	.4	.05	.095	248

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

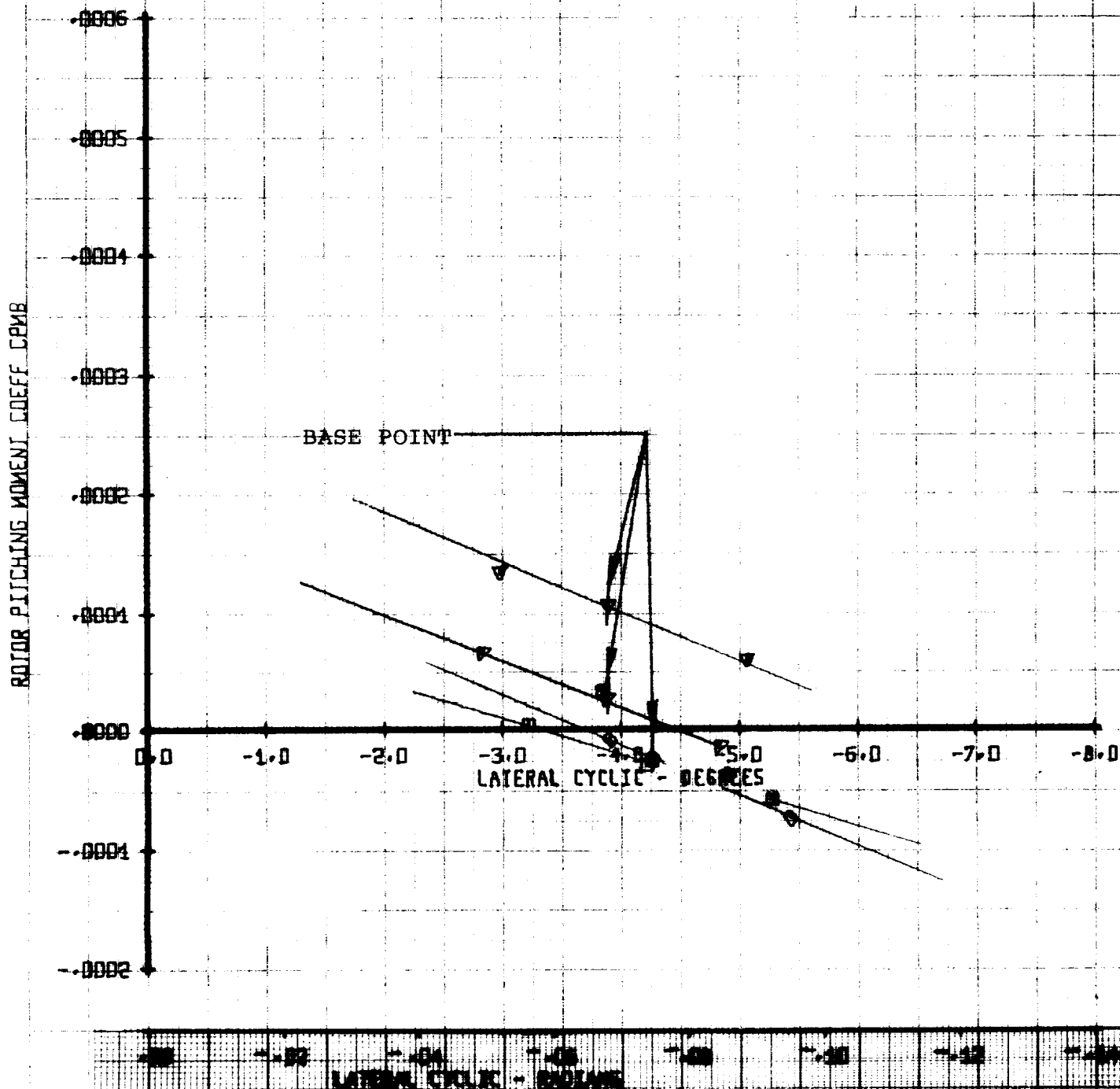


Figure C-5

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/0025B	CT'/5B	VTUN
□	25	.1	.05	.124	62
△	28	.2	.05	.123	124
◇	29	.3	.05	.098	186
▽	30	.4	.05	.095	248

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

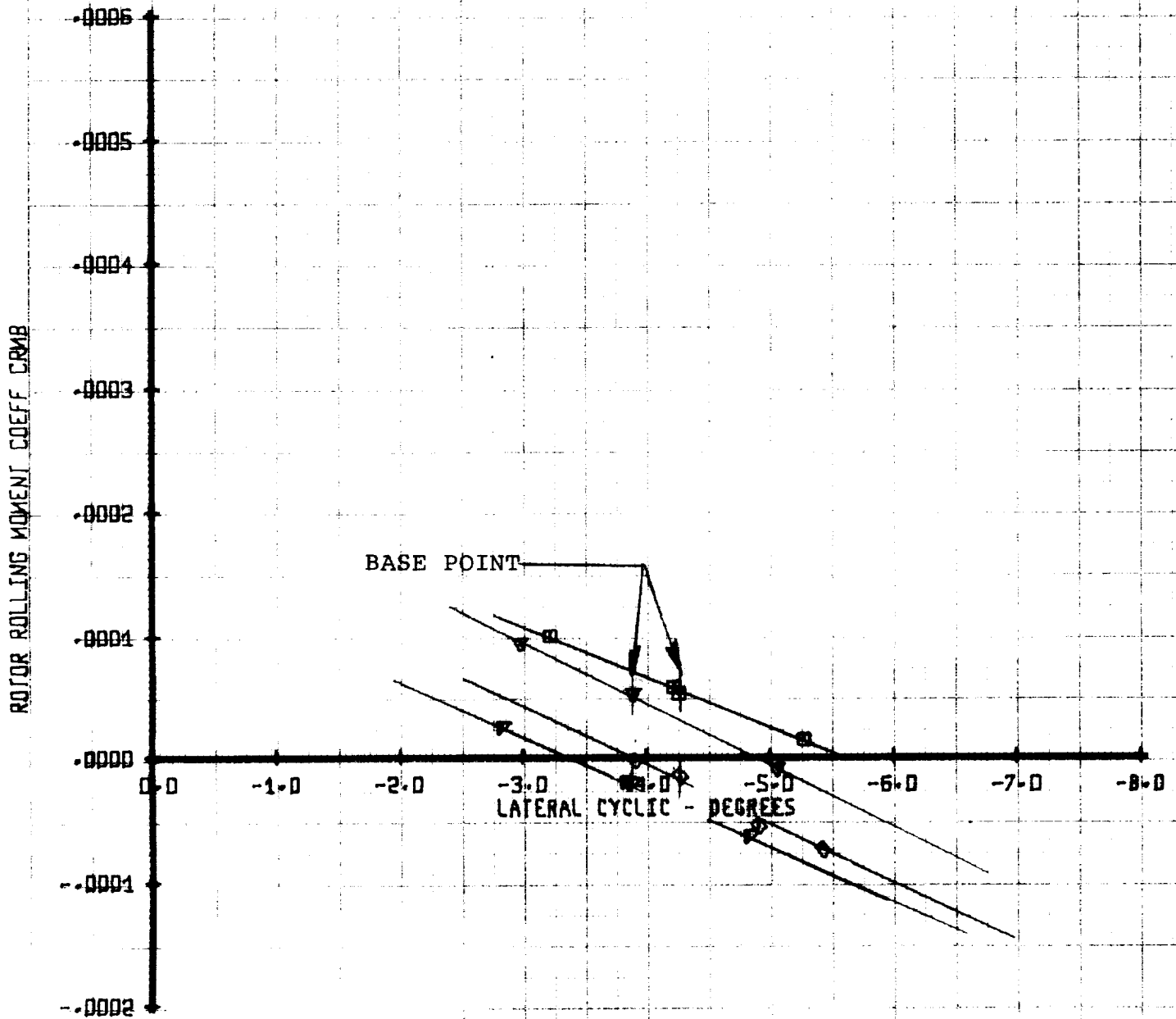


Figure C-6

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/002SB	CT'/SB	VTUN
□	25	.1	.05	.124	62
△	28	.2	.05	.123	124
◇	29	.3	.05	.099	186
▽	30	.4	.05	.095	248

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

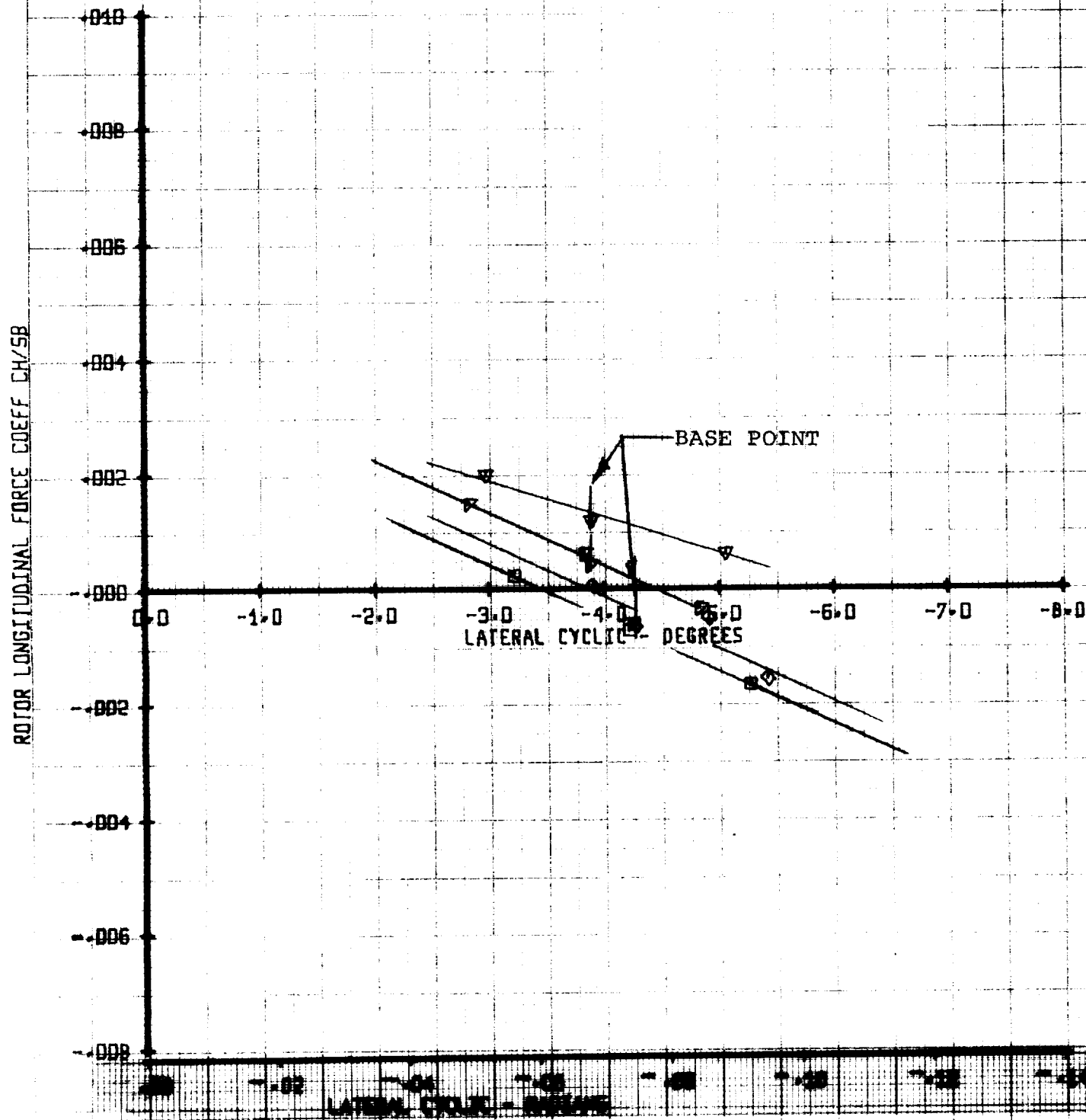


Figure C-7

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	25	.1	.05	.124	62
△	28	.2	.05	.123	124
◇	29	.3	.05	.098	186
▽	30	.4	.05	.095	248

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

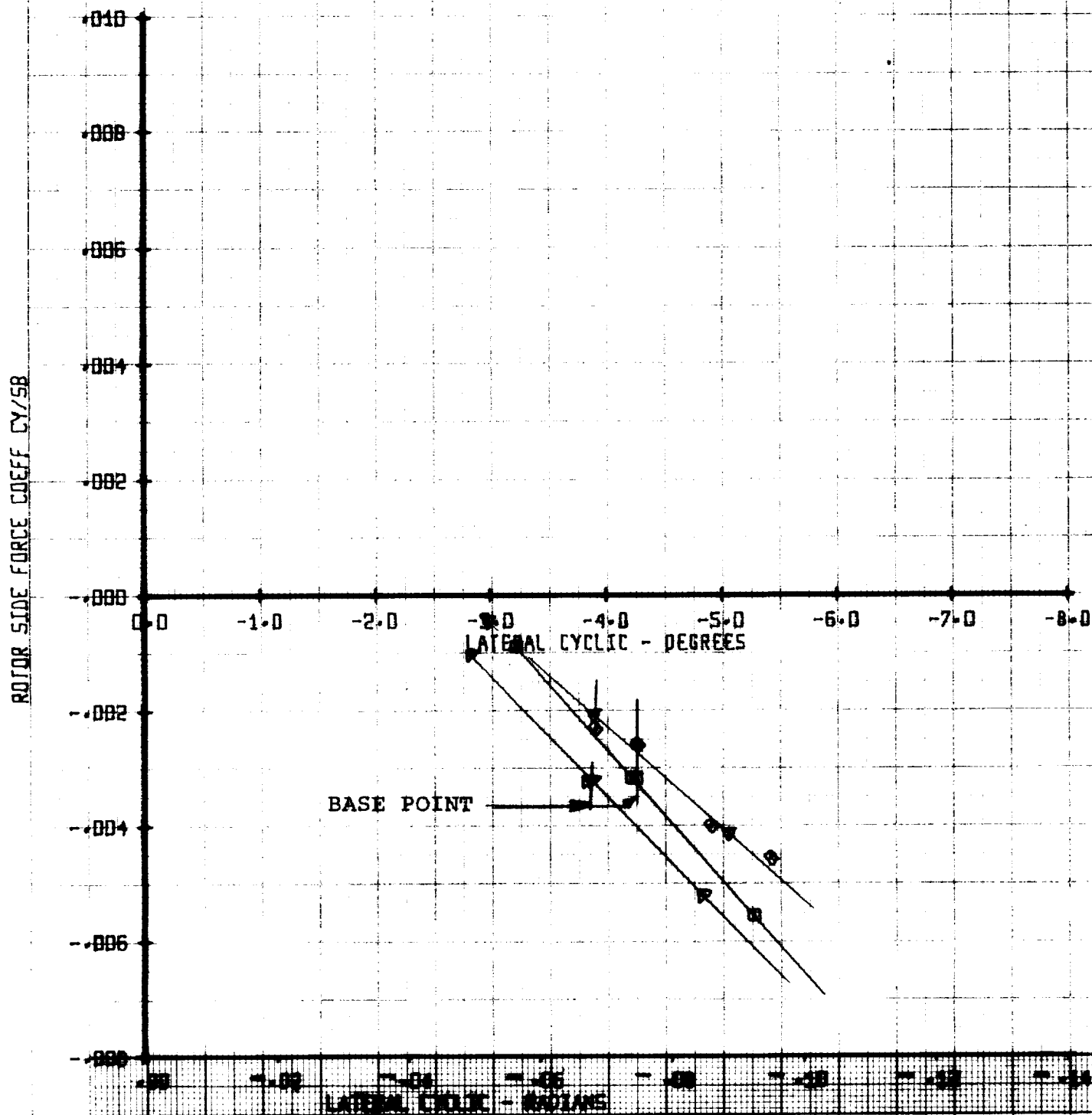


Figure C-8

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT1/5B	VTUN
□	25	.1	.05	.124	62
△	28	.2	.05	.123	124
◇	29	.3	.05	.098	186
▽	30	.4	.05	.095	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

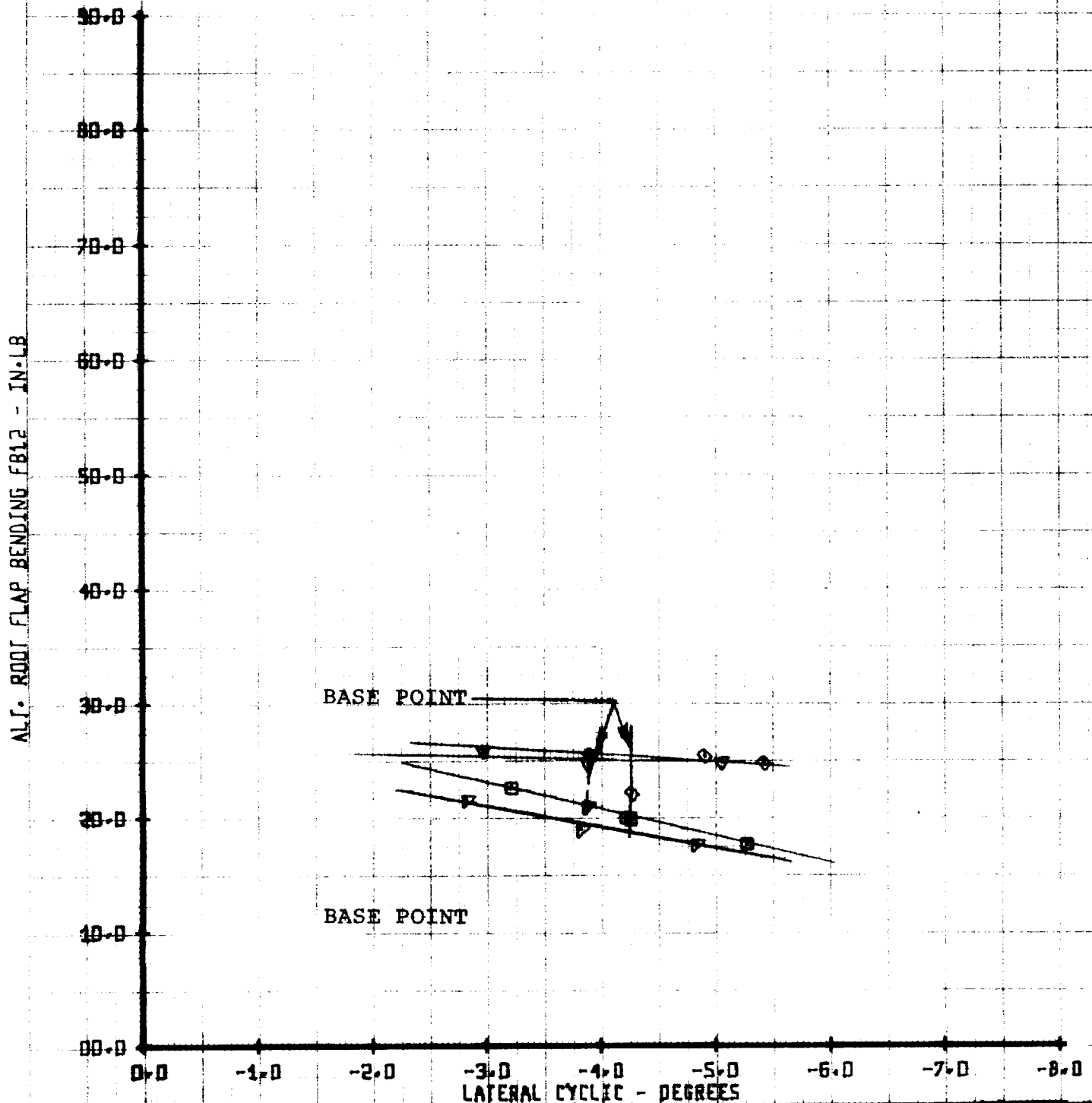


Figure C-9

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN	
□	25	.1	.05	.124	62	+7.1
△	28	.2	.05	.123	124	+0.24
◇	29	.3	.05	.098	186	+0.24
▽	30	.4	.05	.095	248	+0.25

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LATERAL CYCLIC

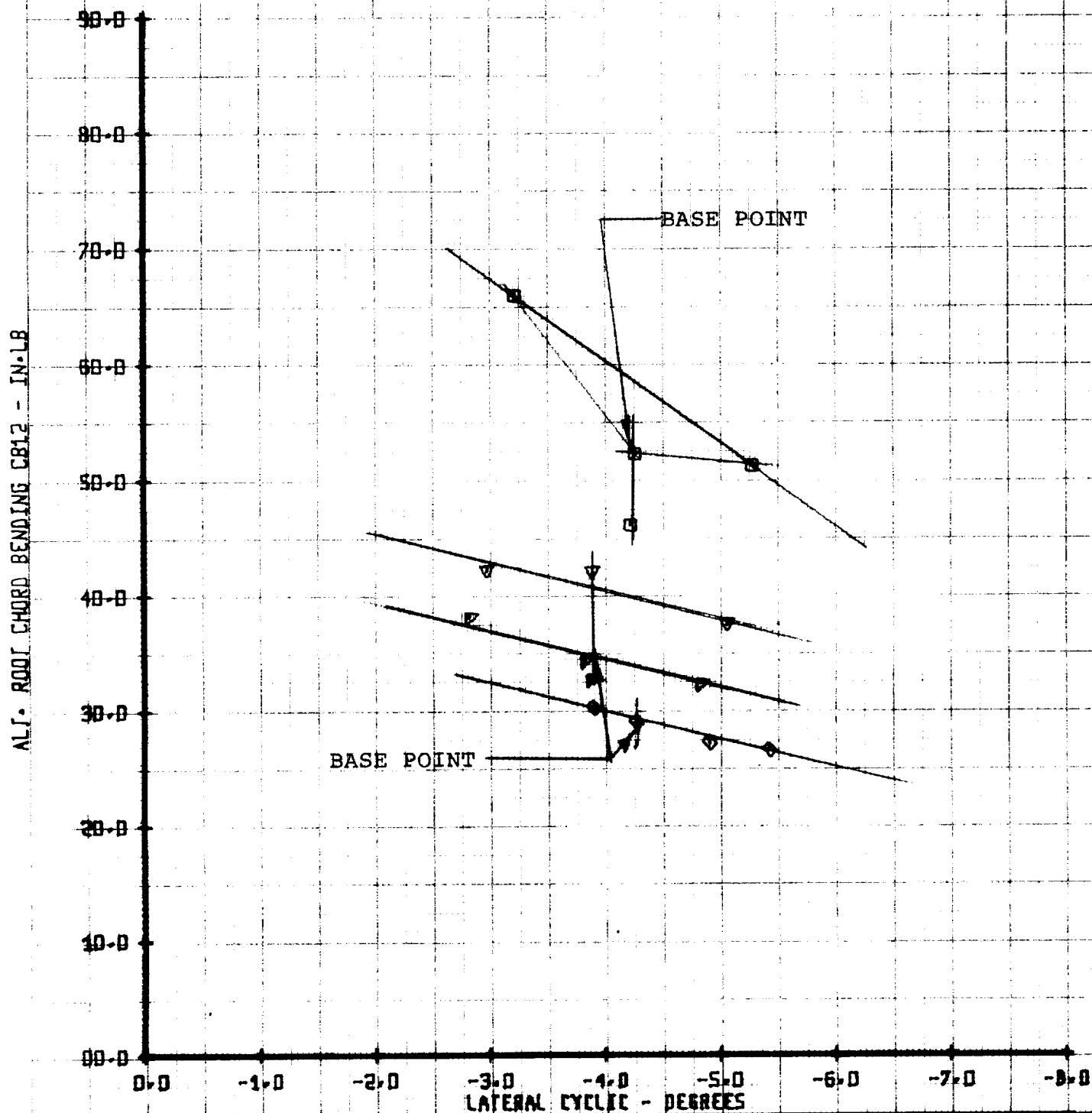


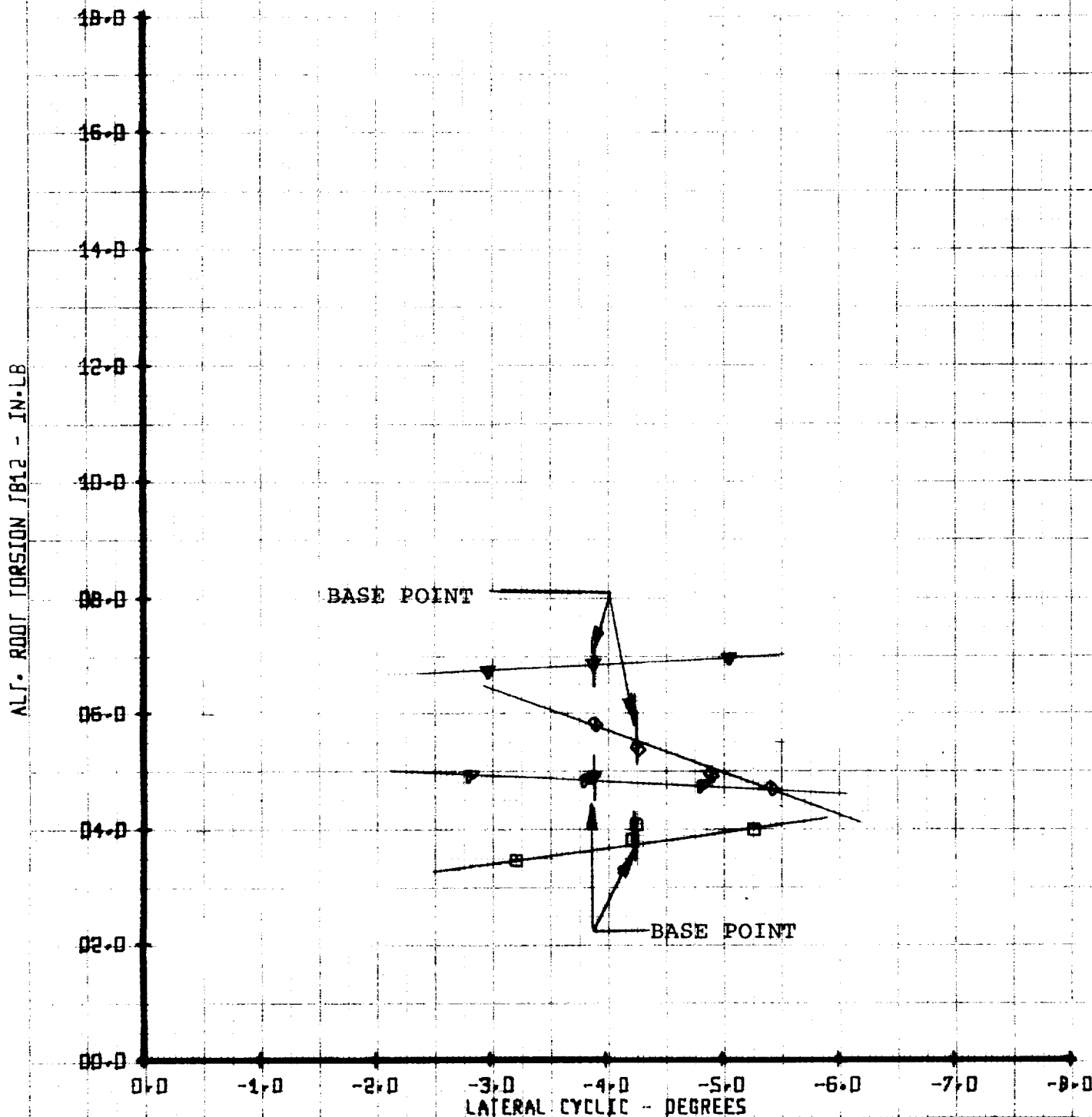
Figure C-10

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-42B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/0025B	CT'/SB	VTUN	$\Delta TL/\Delta A_1$
□	25	.1	.05	.124	62	-.27
△	28	.2	.05	.123	124	+1.0
◇	29	.3	.05	.098	186	+1.2
▽	30	.4	.05	.095	248	-.10

ALTERNATING ROOT TORSION TB12
VERSUS
LATERAL CYCLIC



LATERAL CYCLIC - RADIANS

SET 8
BVWT 187

Figure C-11

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML	X/0025B	CT/5B	VTUN
□	2B	.2	.05	.123	124
△	2B	.2	.05	.090	124

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC

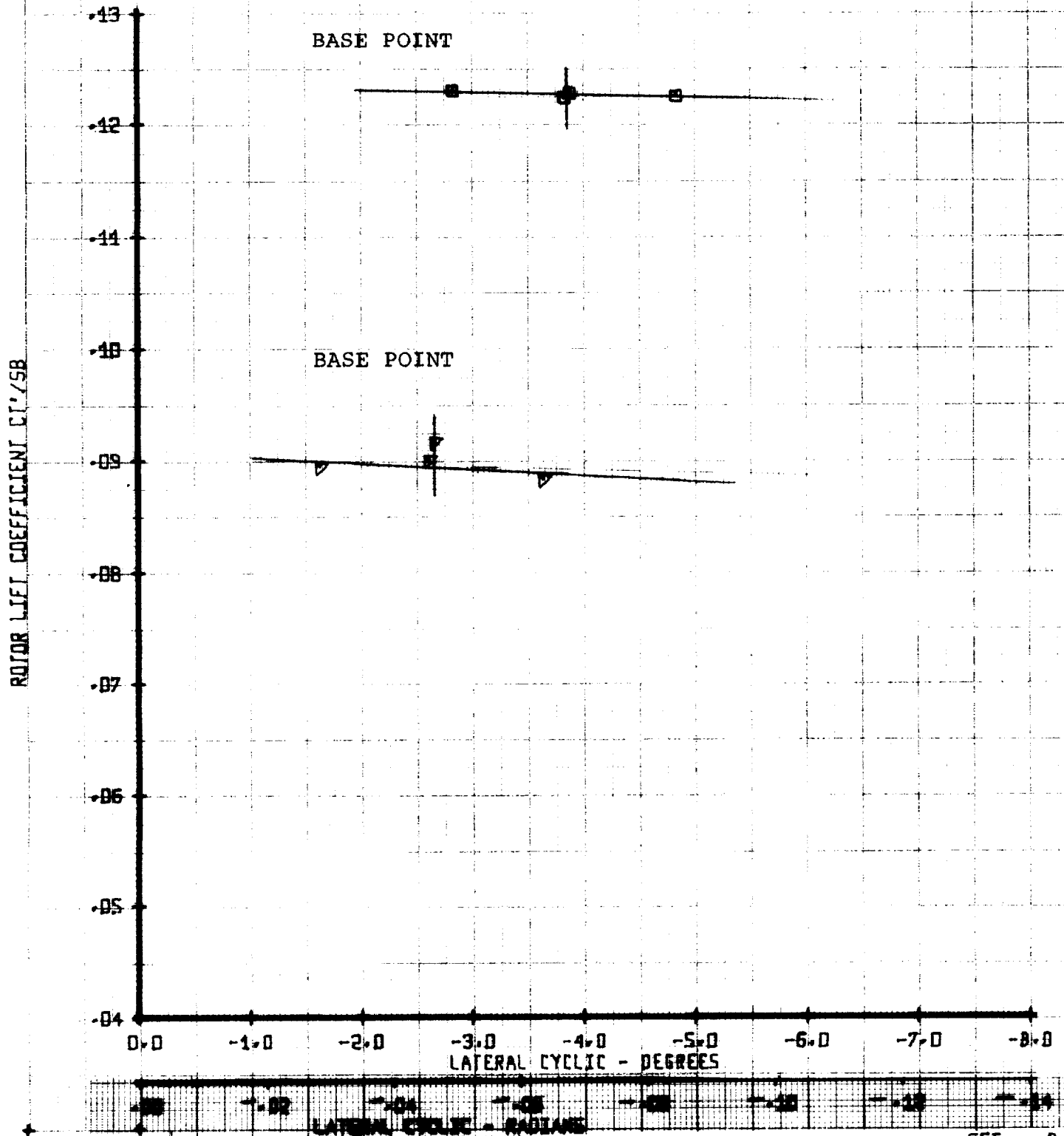


Figure C-12

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML	X/002SB	CI/5B	VTUN
□	2B	.2	.05	.123	124
▽	2B	.2	.05	.090	124

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

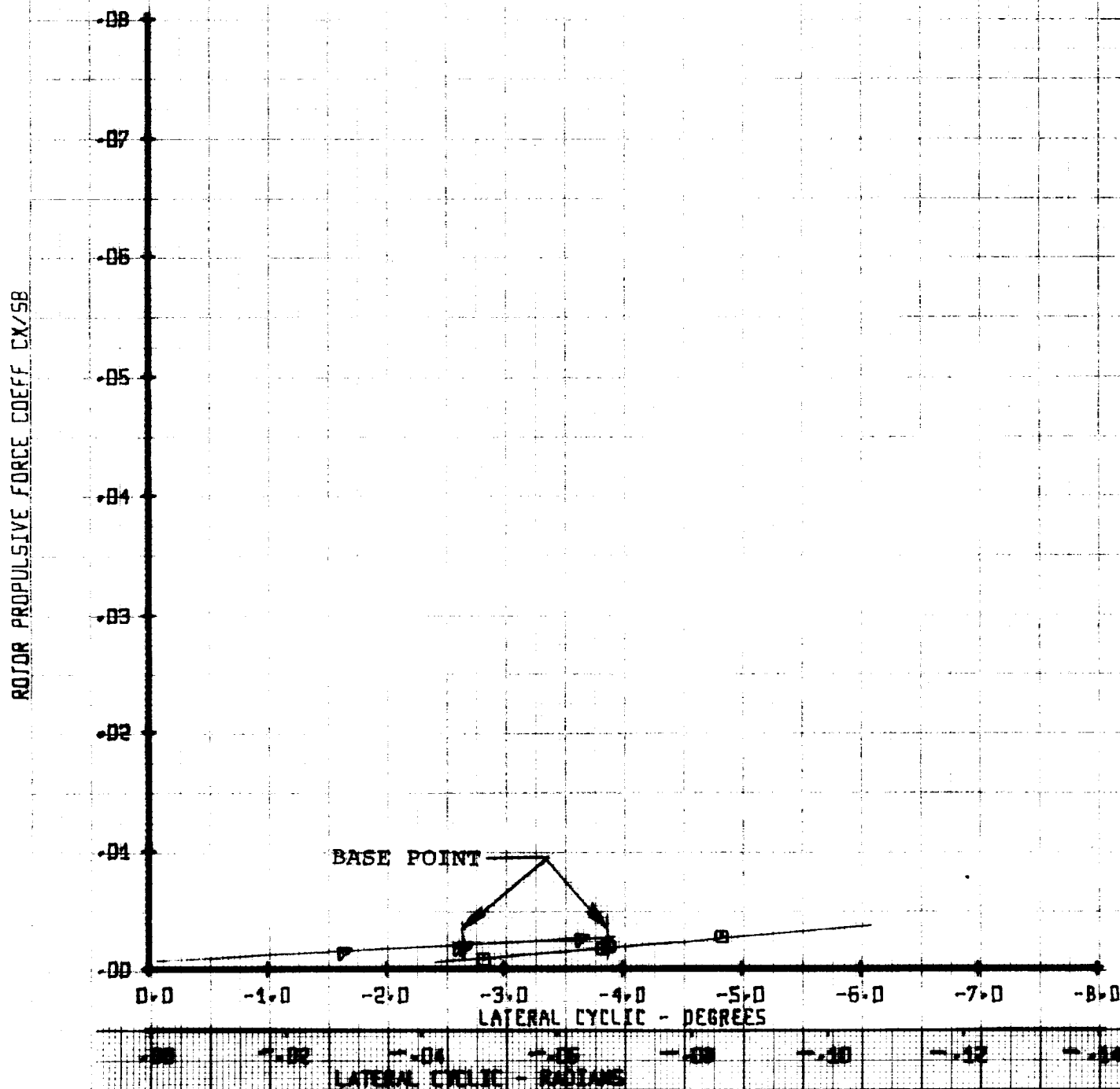


Figure C-13

LIFT-PROPULSIVE FORCE LIMIT TEST

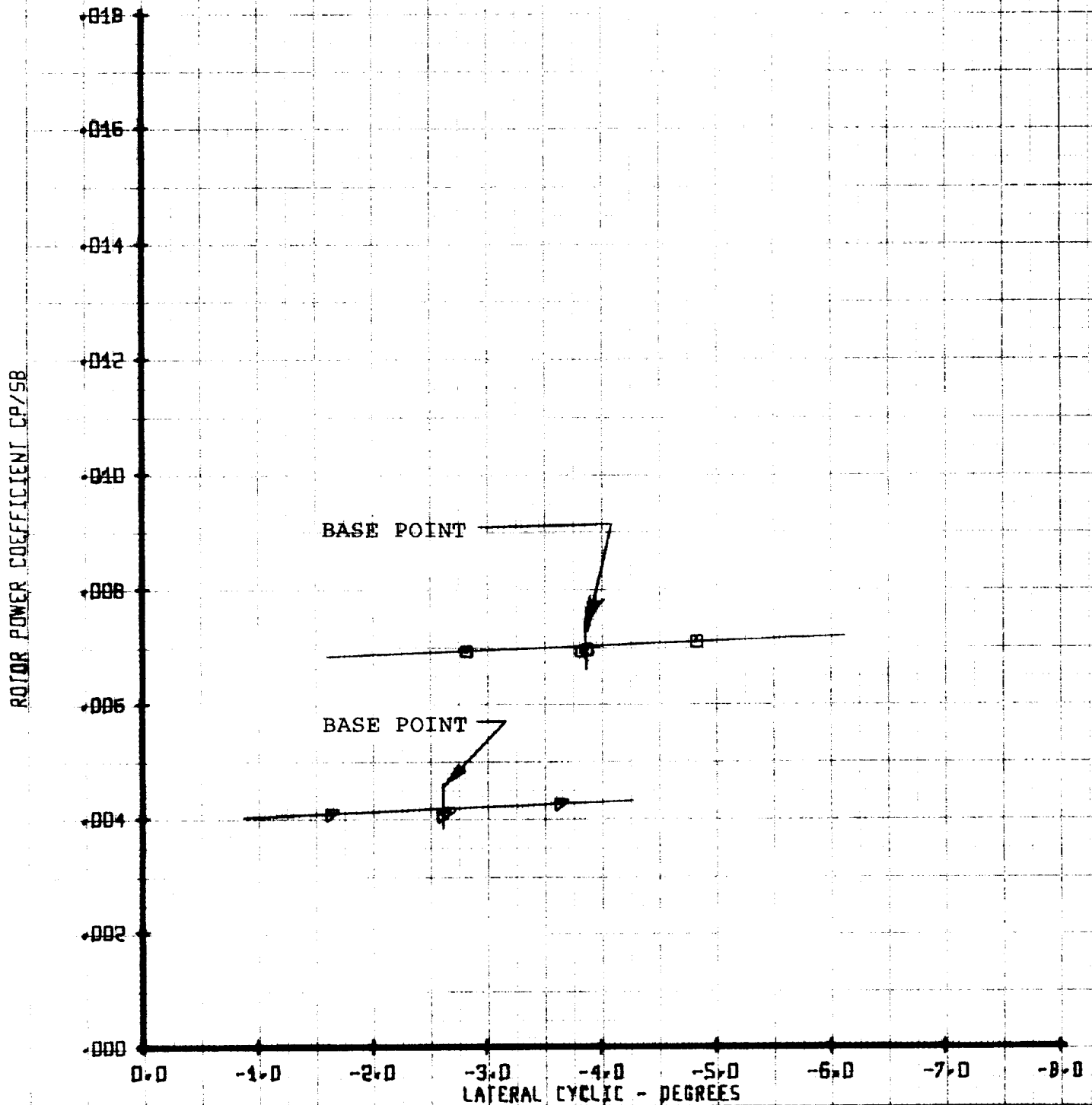
1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	28	.2	.05	.123	124
△	28	.2	.05	.090	124

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
0	28	.2	.05	.123	124
7	28	.2	.05	.090	124

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

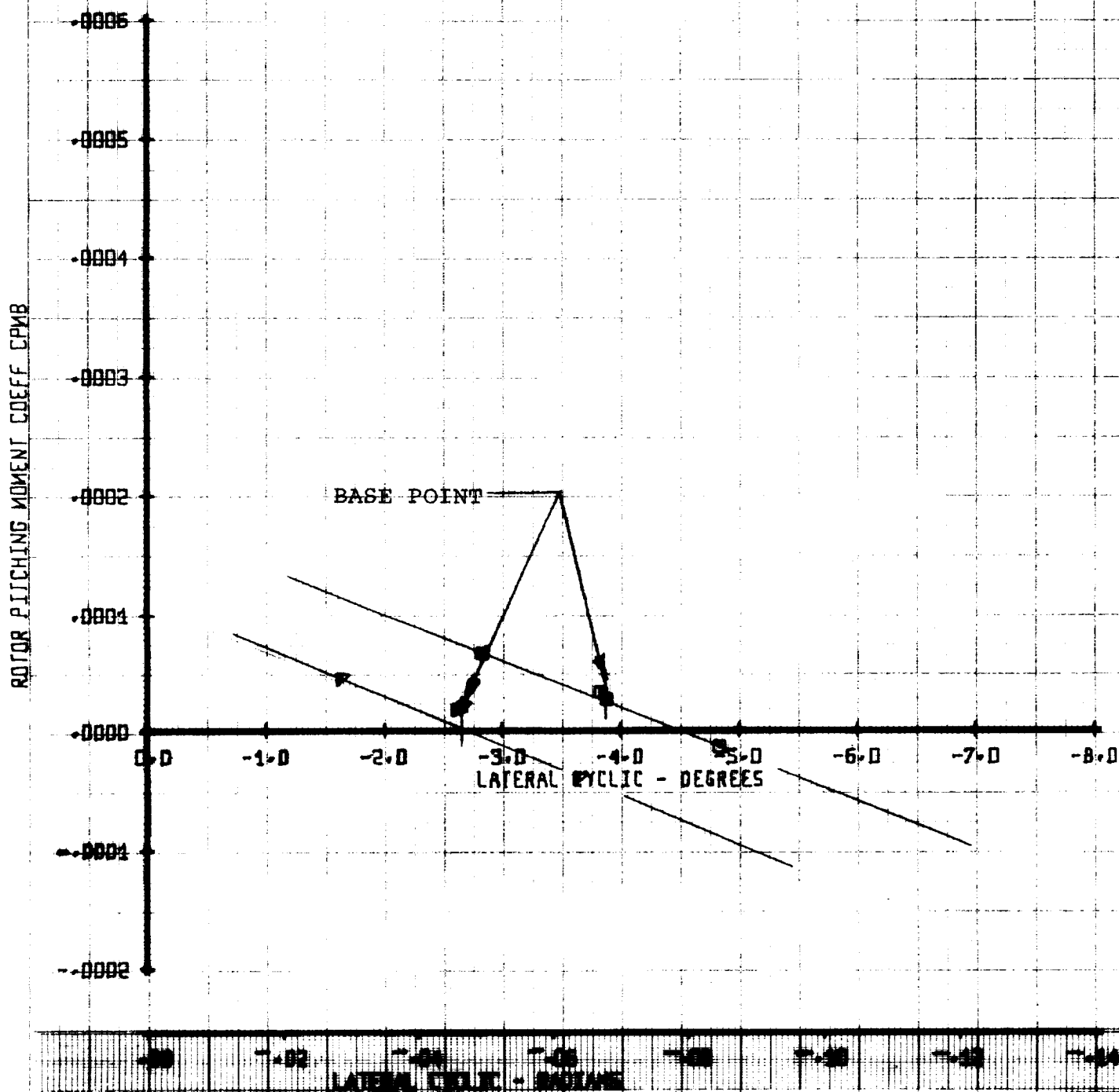


Figure C-15

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT/58	VTUN
□	2B	.2	.05	.123	124
▽	2B	.2	.05	.090	124

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

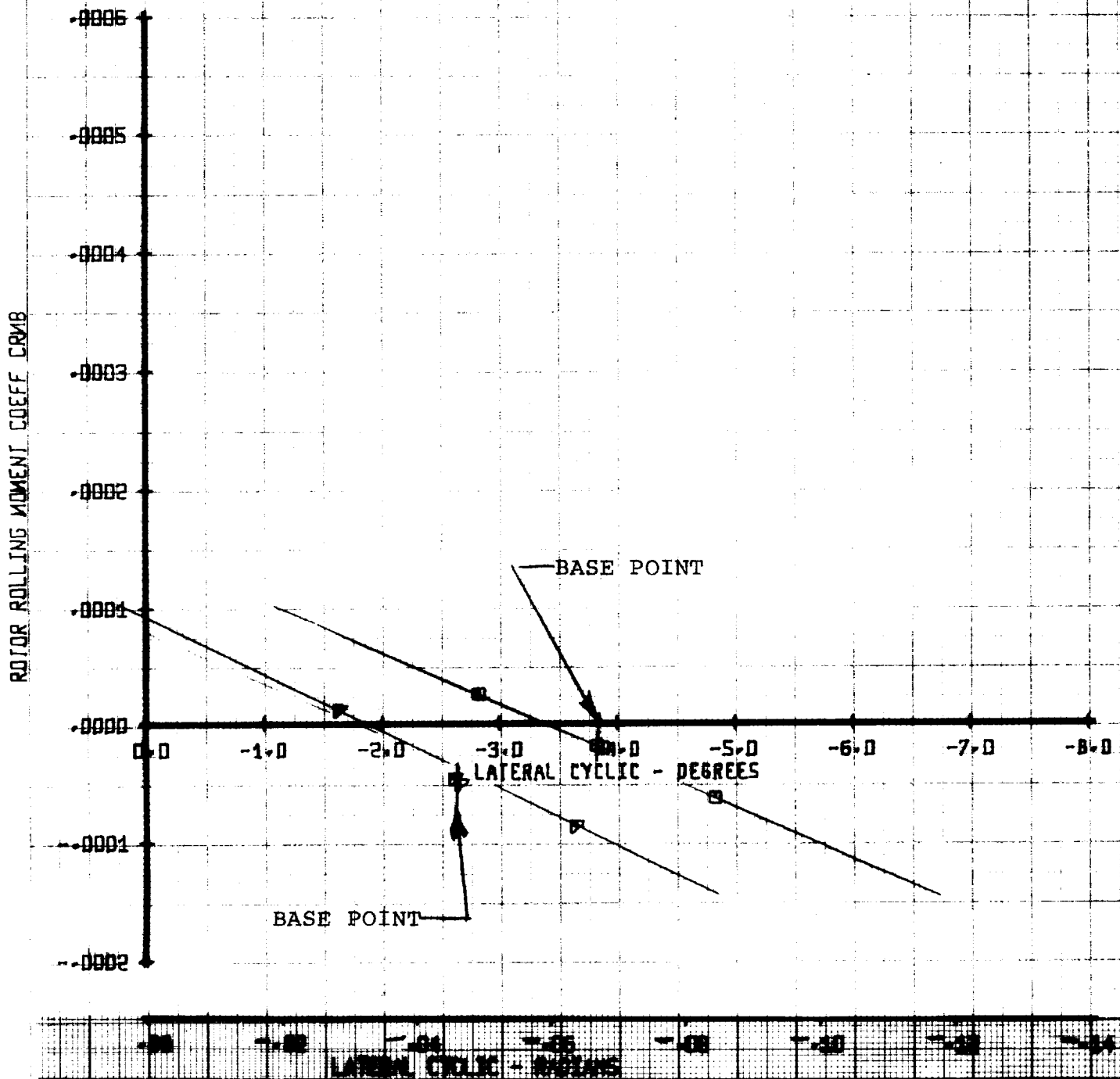


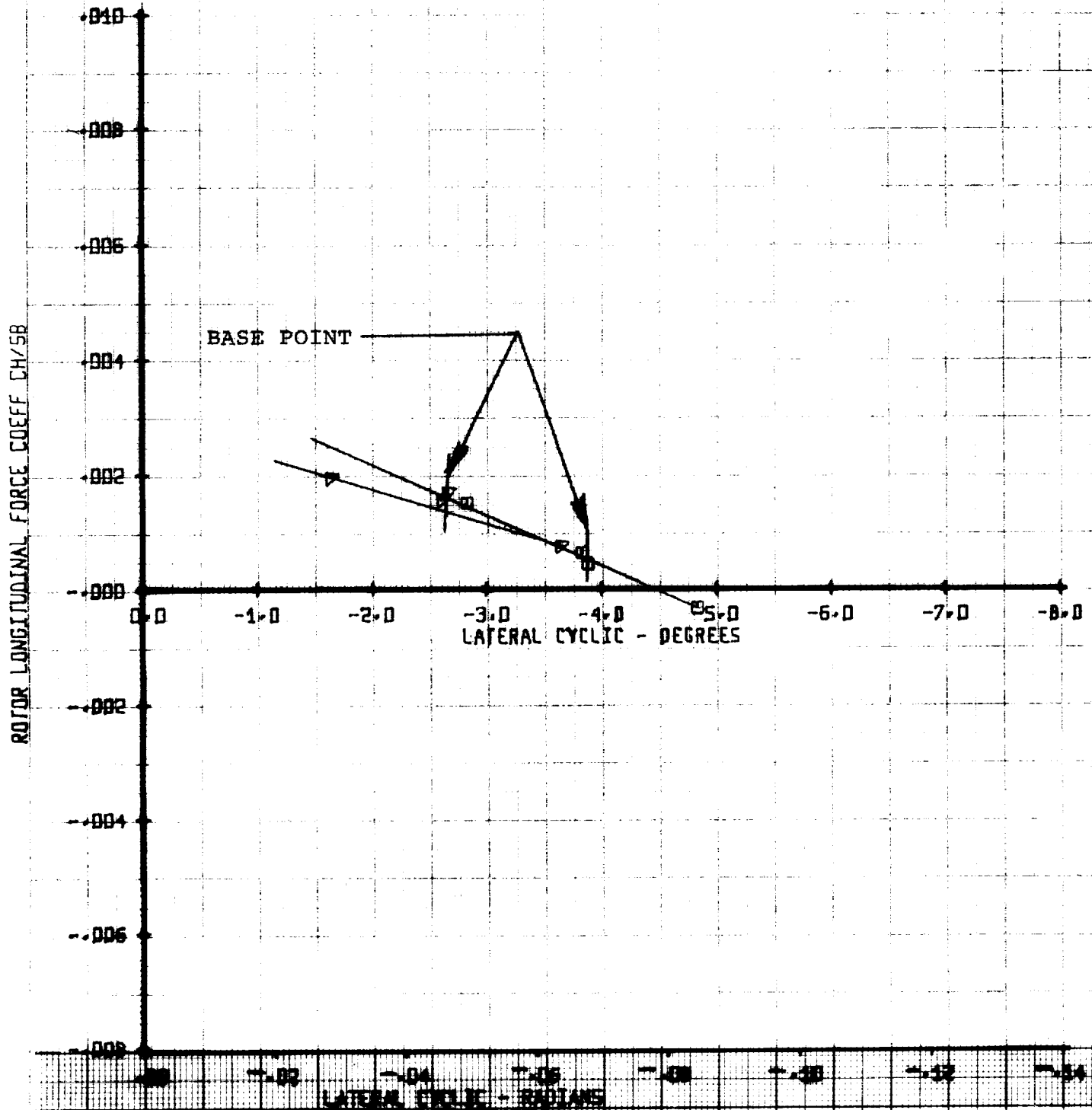
Figure C-16

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	28	.2	.05	.123	124
△	28	.2	.05	.090	124

ROTOR LONGITUDINAL FORCE COEFFICIENT
 VERSUS
 LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CI/58	VTUN
□	28	.2	.05	.123	124
▽	28	.2	.05	.090	124

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

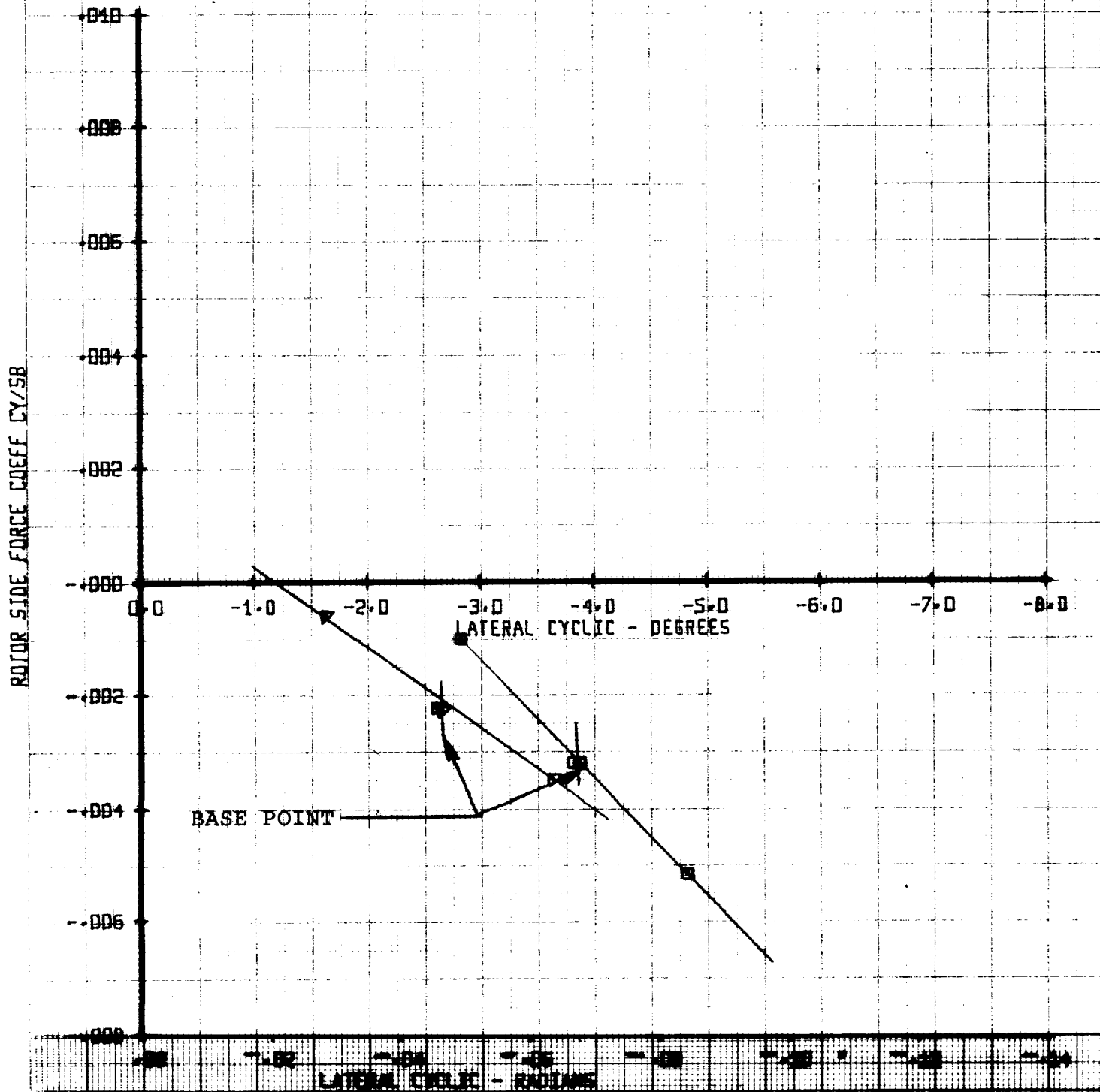


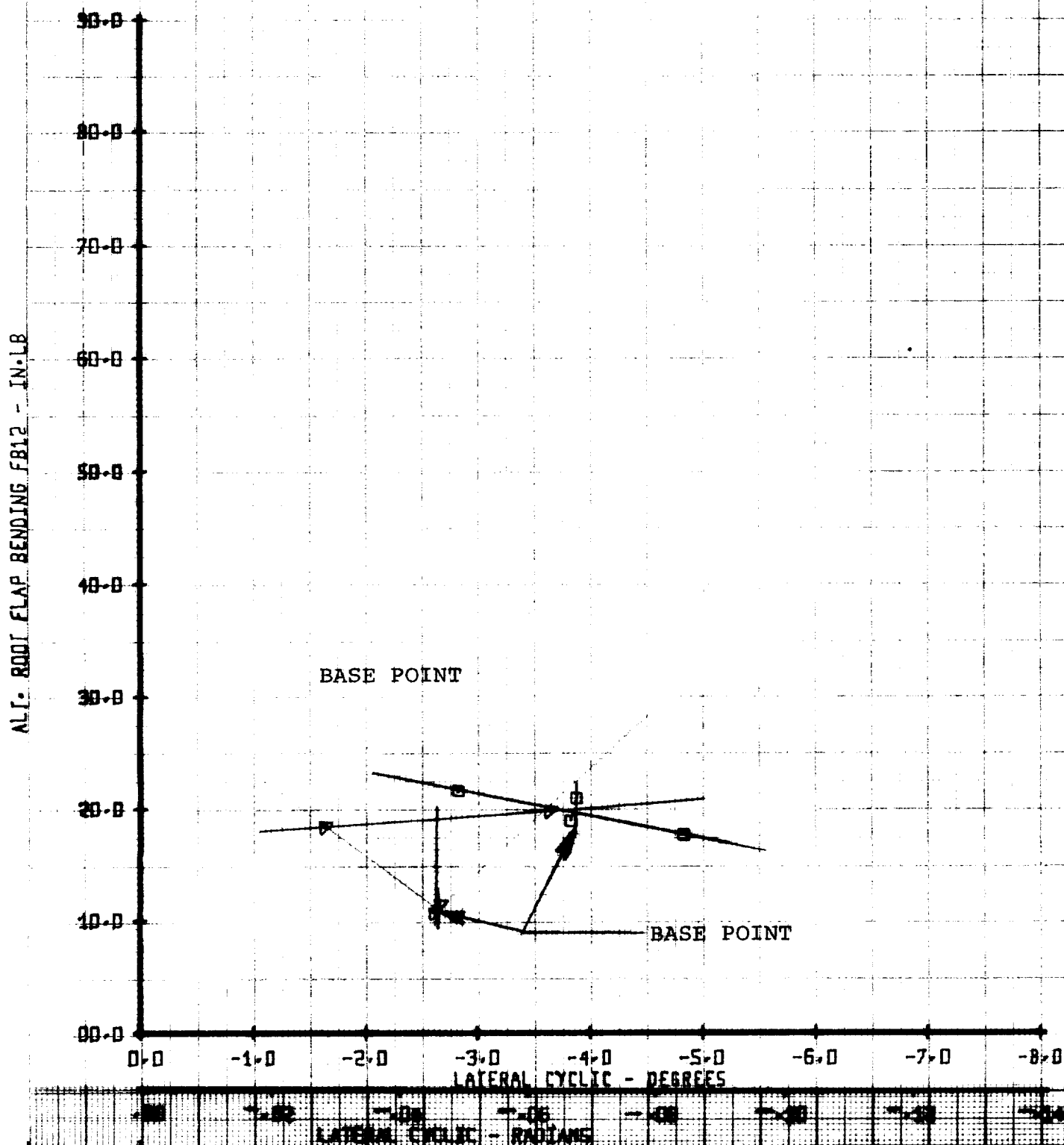
Figure C-18

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/58	VTUN
□	28	.2	.05	.123	124
▽	28	.2	.05	.090	124

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

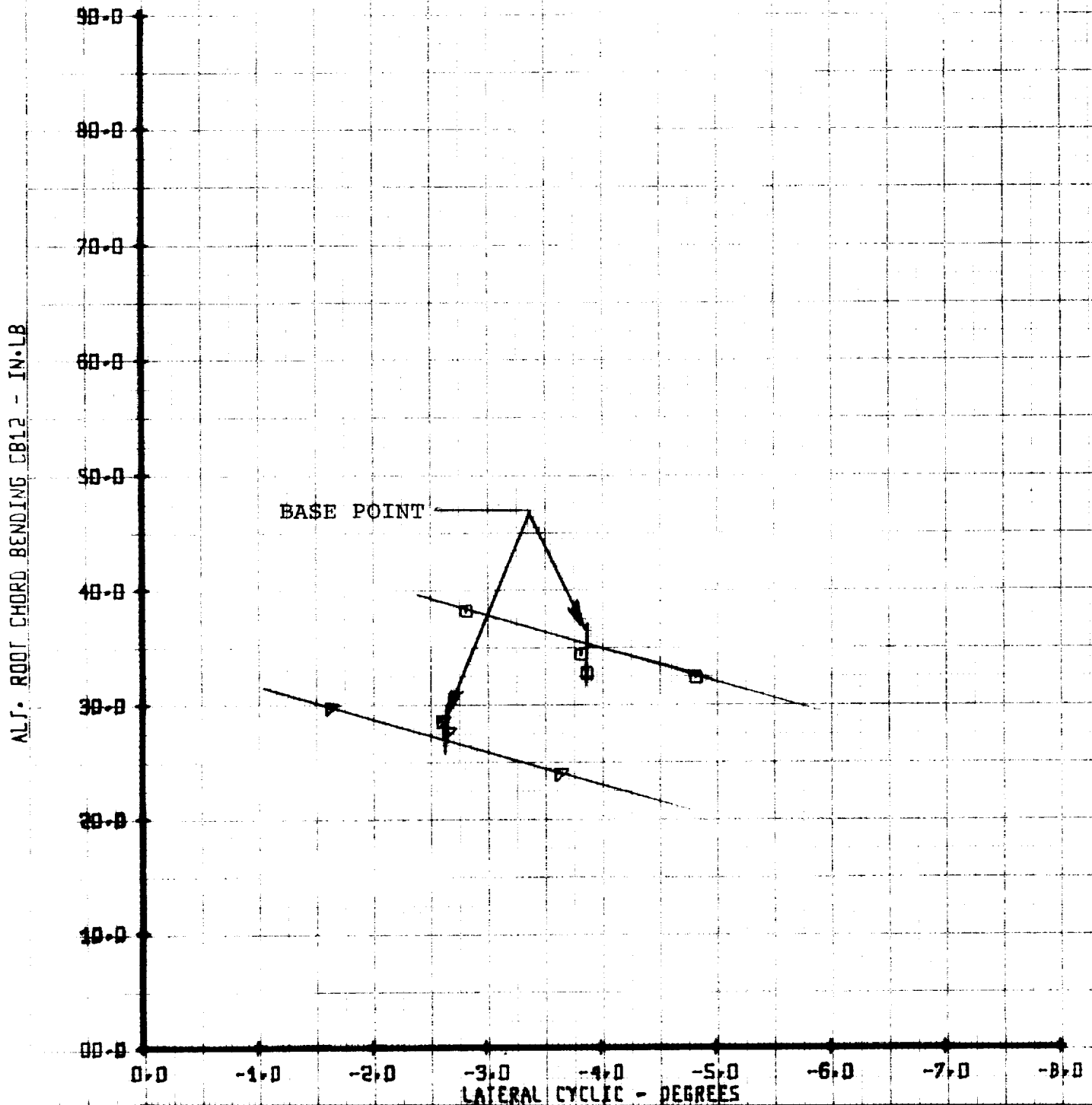


LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00250	CT/50	VTUN
□	2B	.2	.05	.123	124
▽	2B	.2	.05	.090	124

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47 ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
0	28	.2	.05	.129	124
1	28	.2	.05	.090	124

ALTERNATING ROOT TORSION TB12

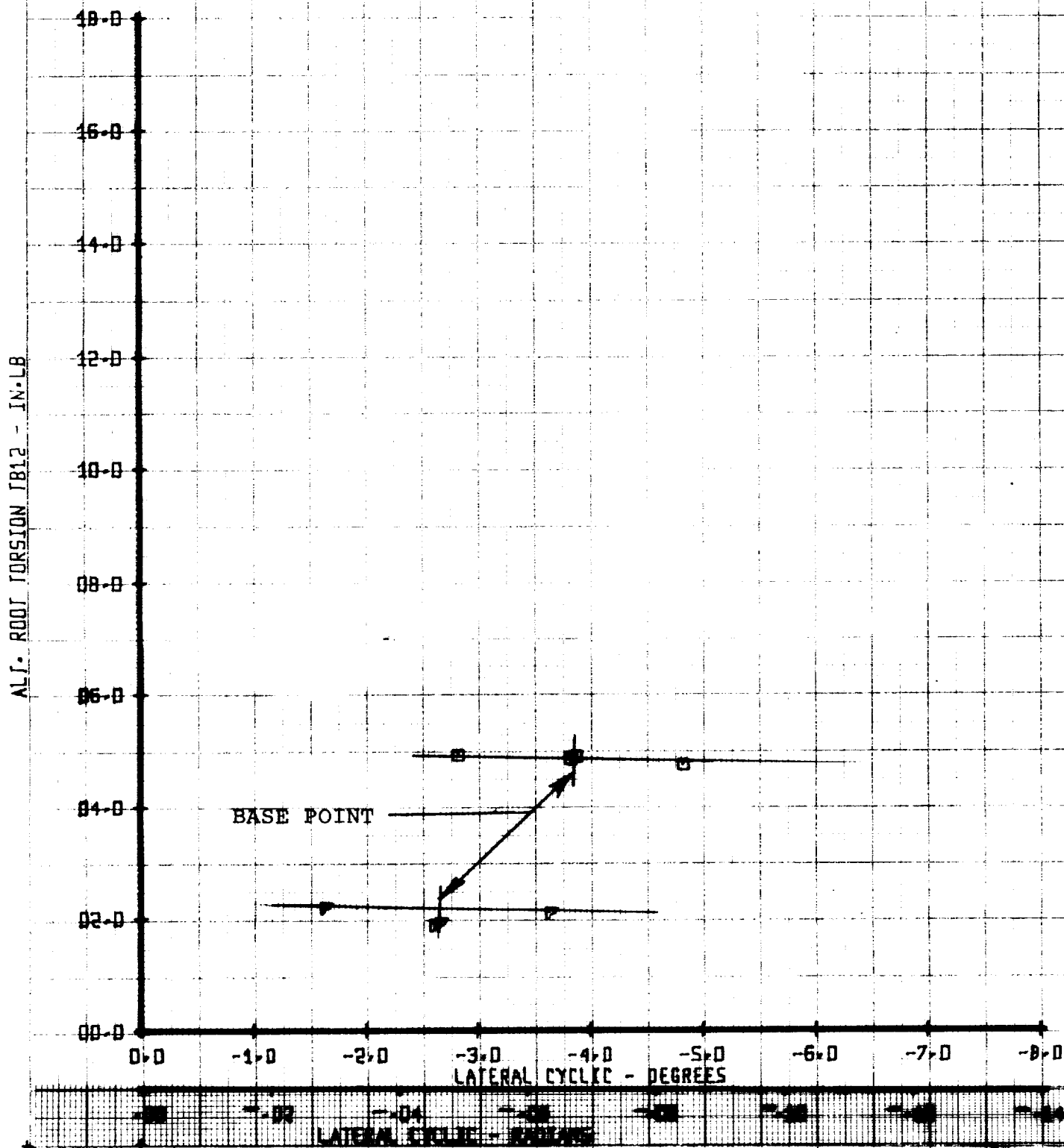
VERSUS
LATERAL CYCLICSET 9
BVWT 187

Figure C-21

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML*	X/00258	CT'/SB	YTUN
0	30	.4	.05	.095	248
Δ	30	.4	.05	.076	248

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC

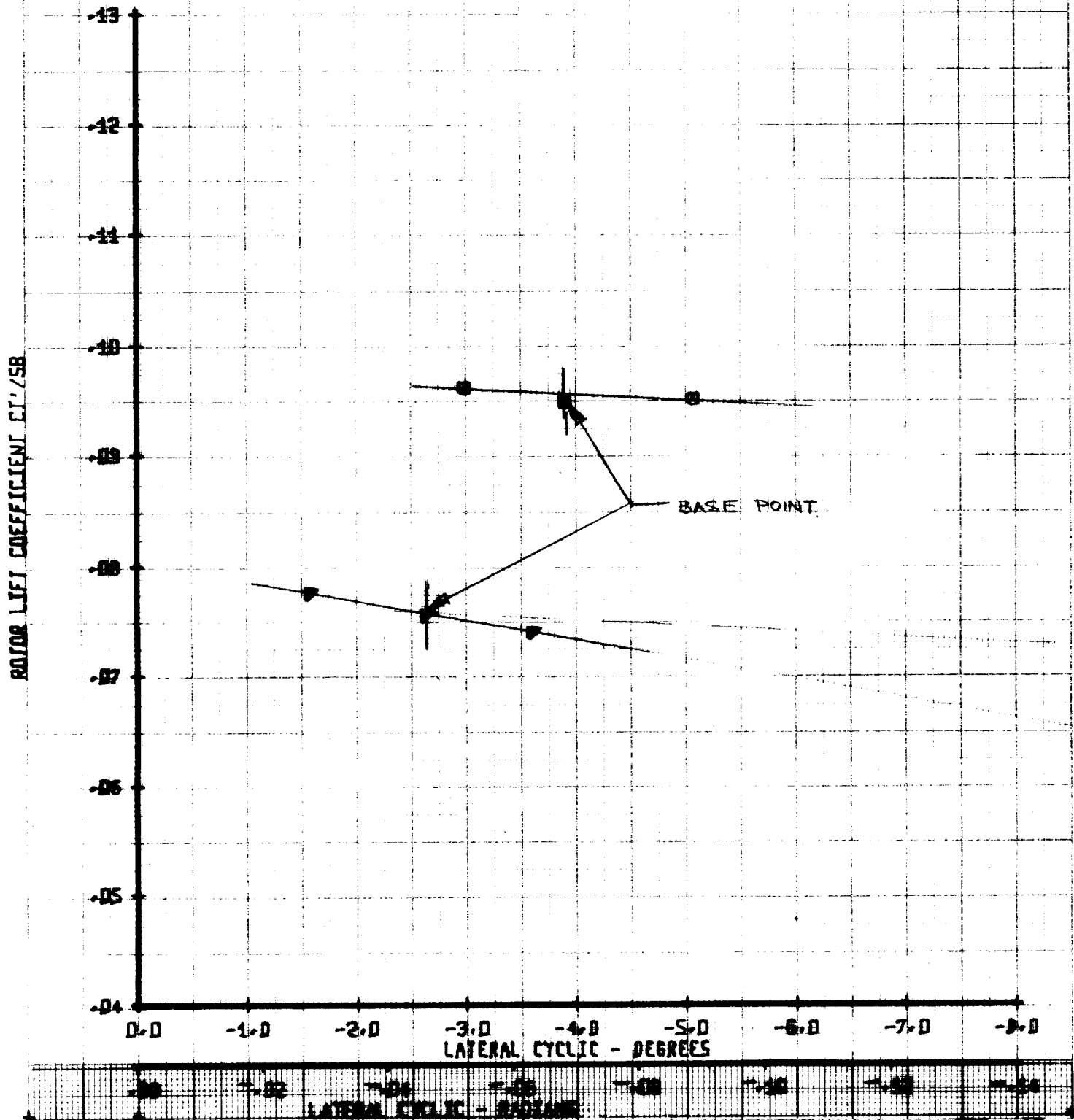


Figure C-22

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	ML	X/0025B	CT'/5B	VTUN
□	30	.4	.05	.095	24B
▽	30	.4	.05	.076	24B

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LATERAL CYCLIC

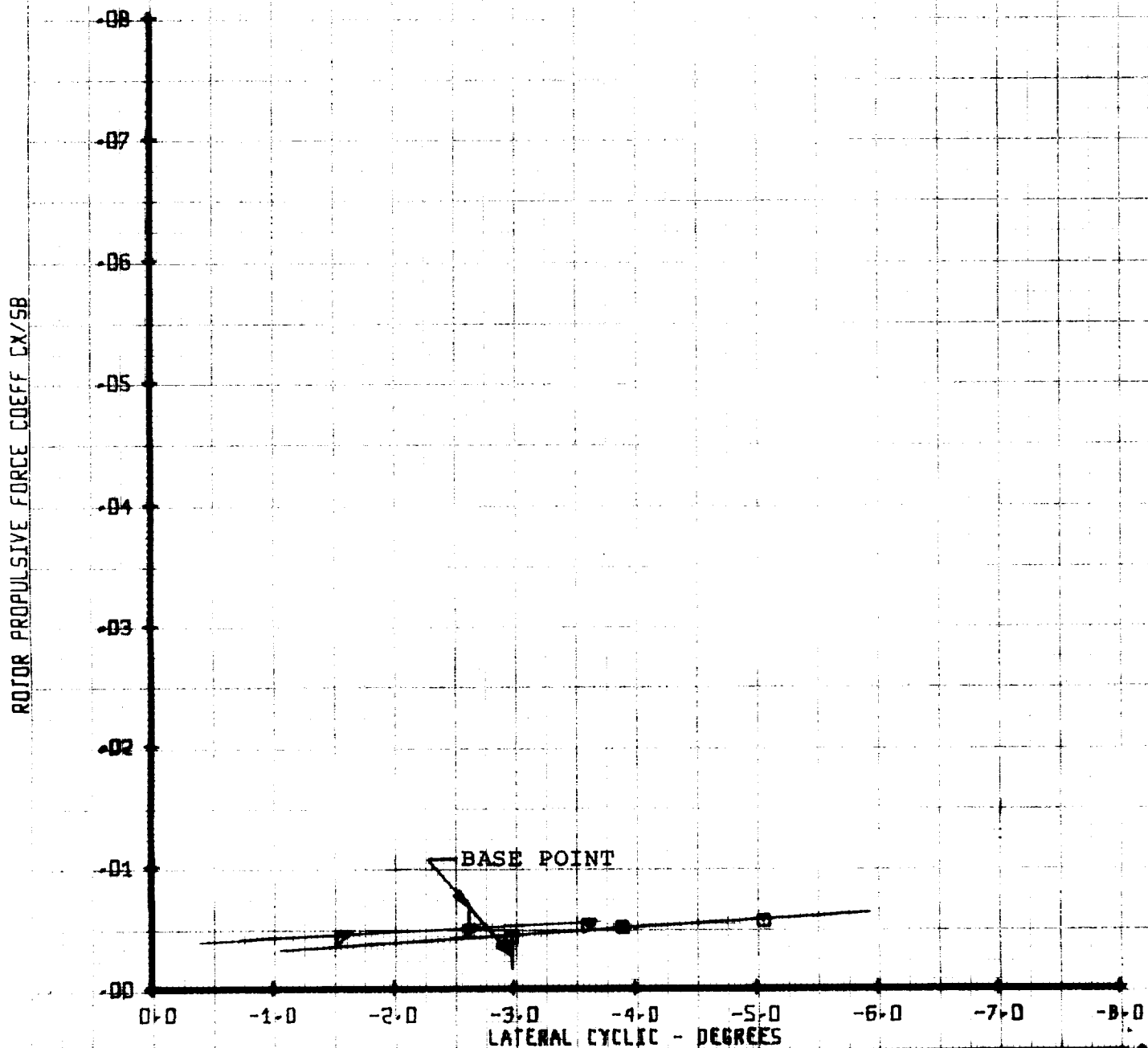


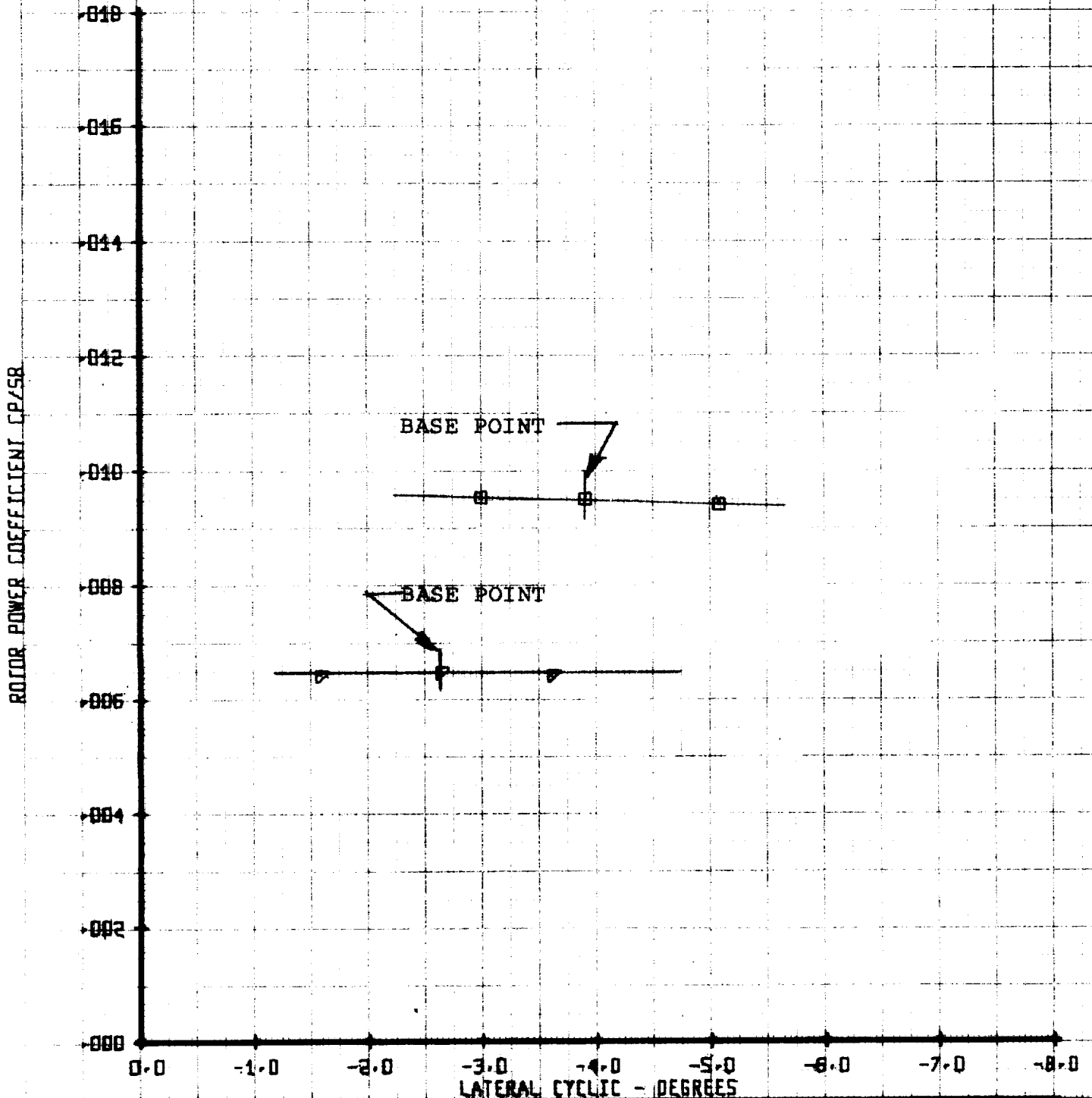
Figure C-23

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-42B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML	X/00258	CT/58	VTUN
0	30	.4	.05	.095	248
1	30	.4	.05	.076	248

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML'	X/OD258	CT'/SB	YTLN
□	30	.4	.05	.095	248
▽	30	.4	.05	.076	248

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

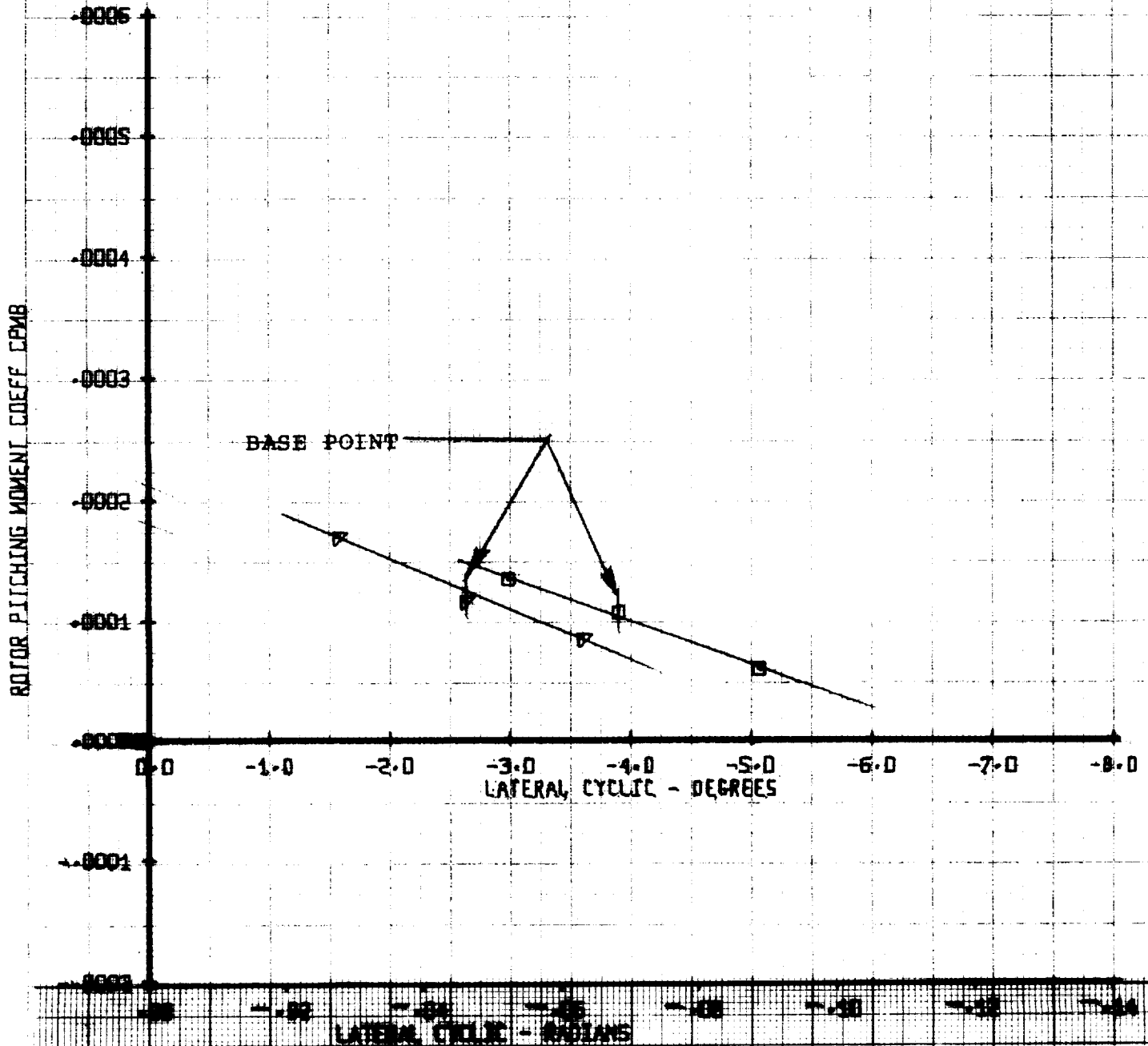


Figure C-25

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MLP	X/OD2SB	CT/5B	YTLN
□	30	.4	.05	.095	248
△	30	.4	.05	.076	248

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

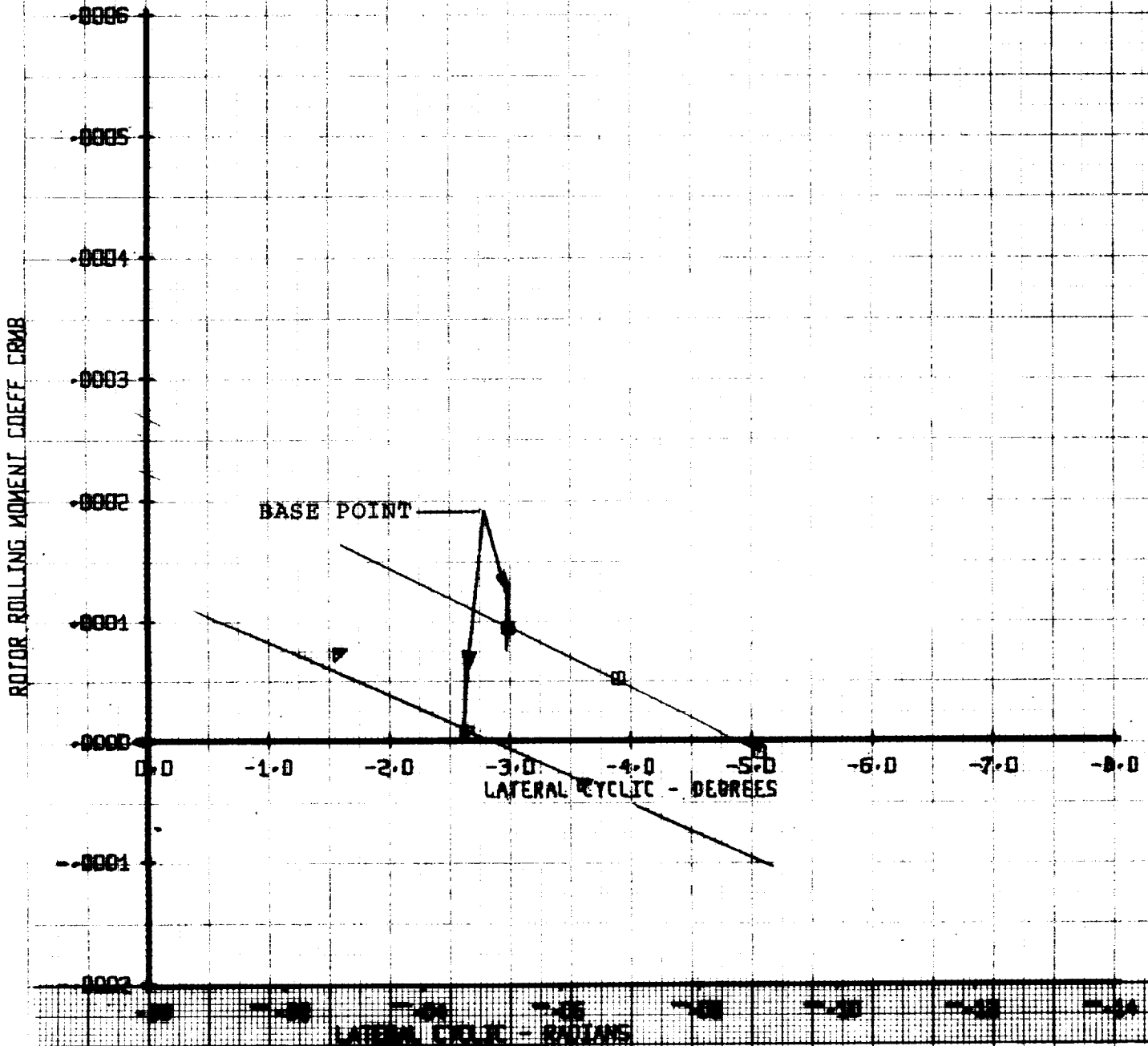


Figure C-26

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/00258	CT'/SB	VTUM
□	30	.4	.05	.095	248
▽	30	.4	.05	.076	248

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

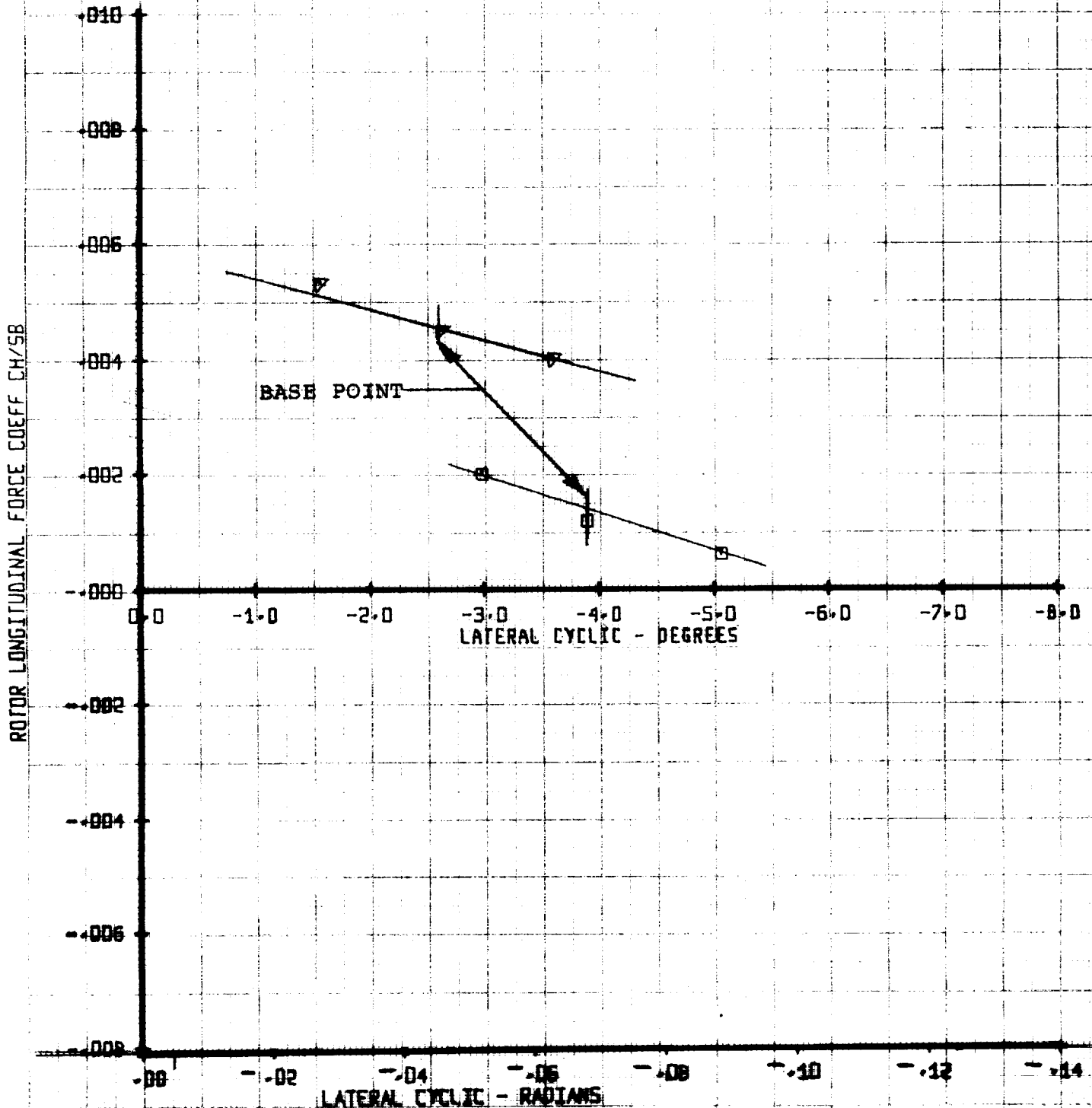


Figure C-27

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/258	VTUN
□	30	.4	.05	.095	248
▽	30	.4	.05	.076	248

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

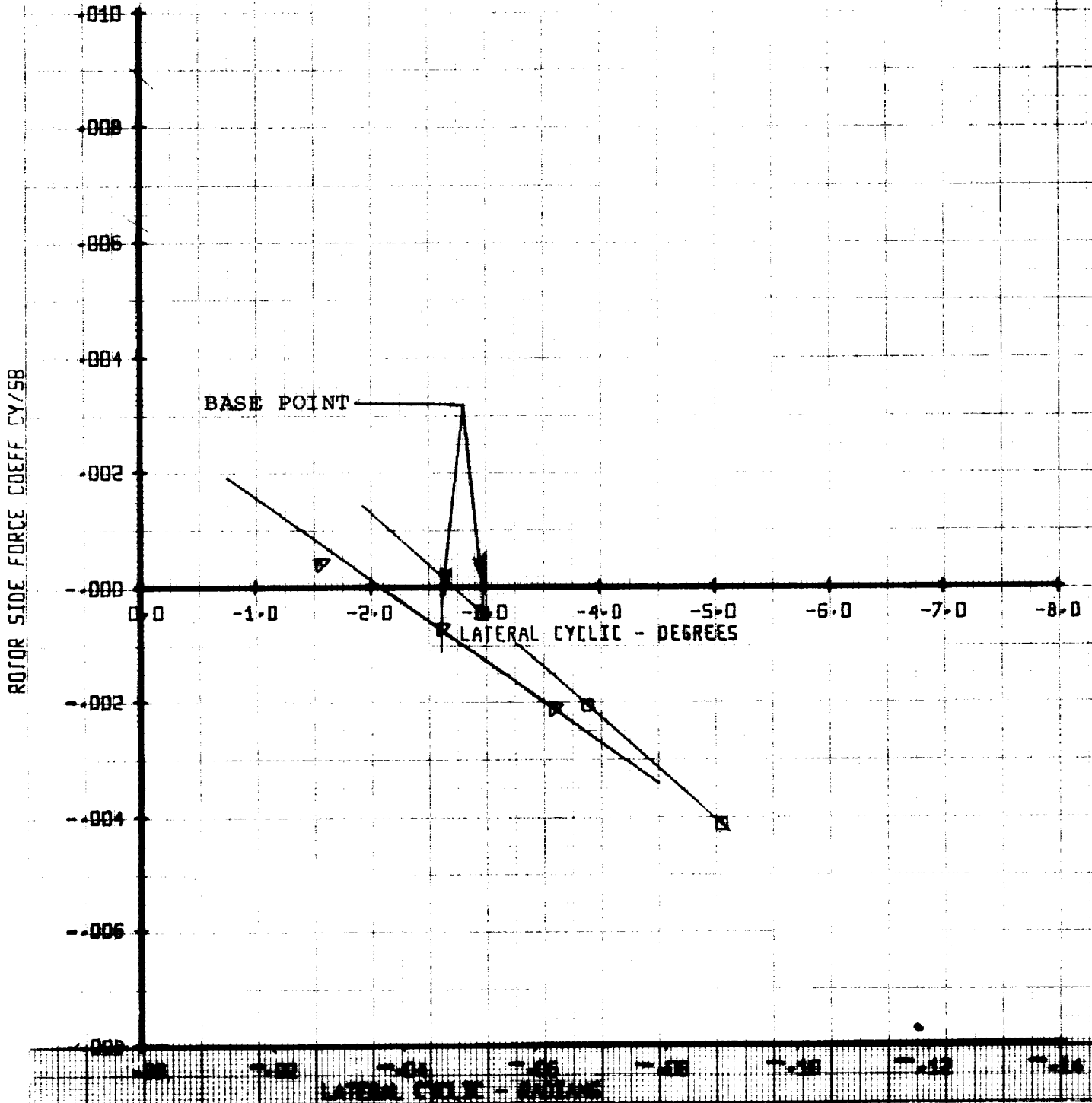


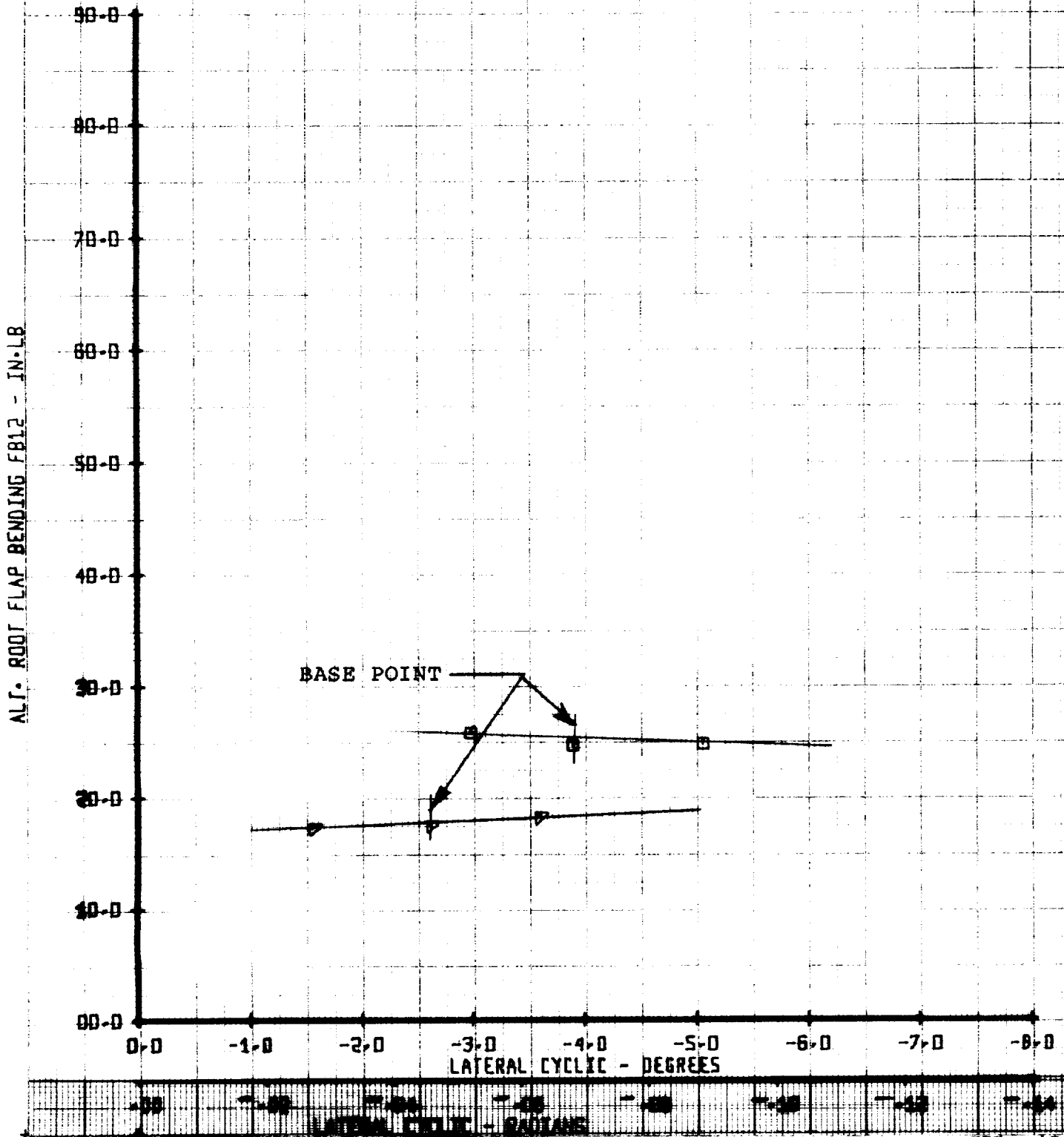
Figure C-28

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	30	.4	.05	.095	24B
▽	30	.4	.05	.076	24B

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC



SET 10
BVMT 187

Figure C-29

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
□	30	.4	.05	.095	248
▽	30	.4	.05	.076	248

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LATERAL CYCLIC

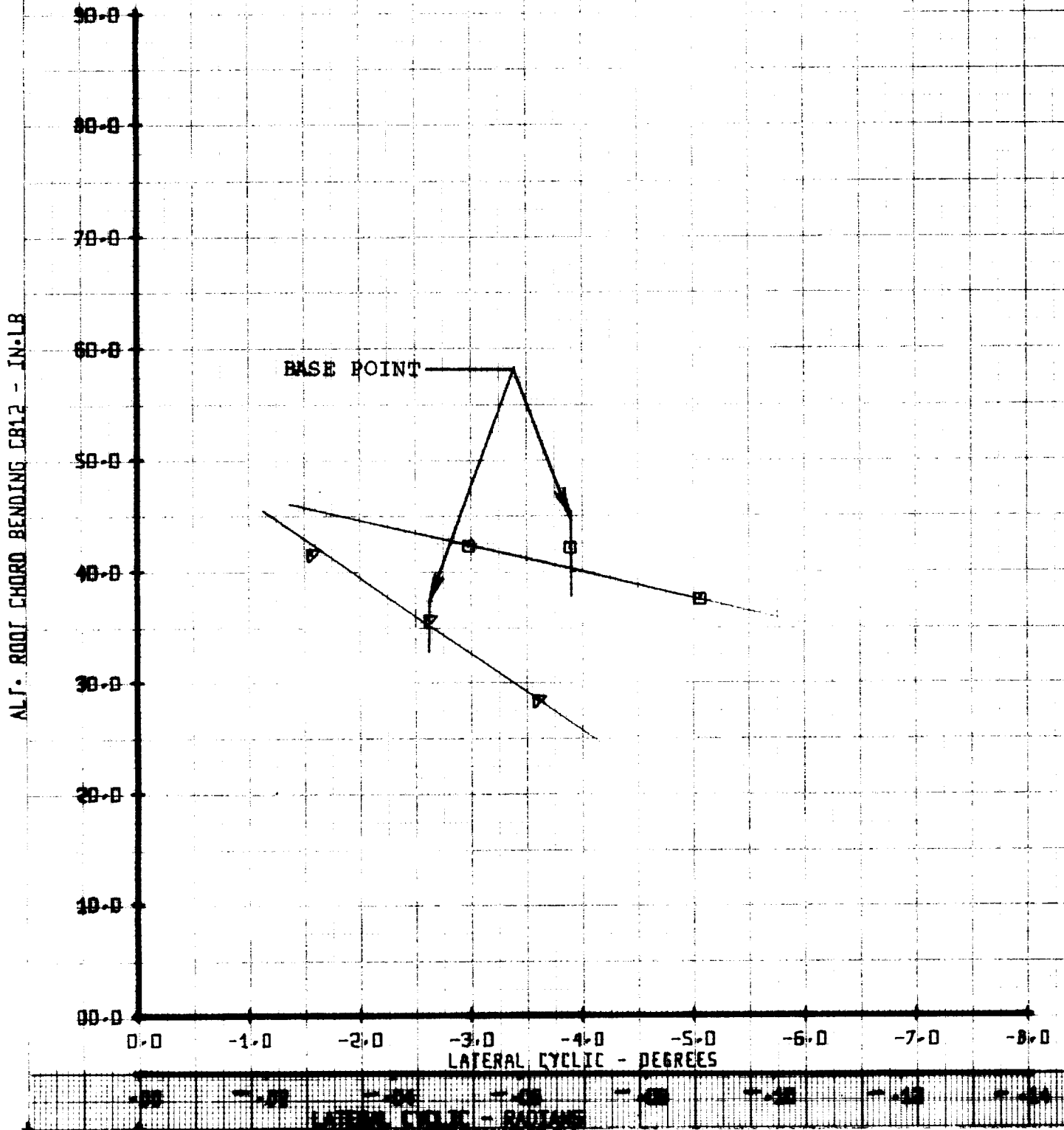


Figure C-30

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MJ	X/00258	CT'/SB	VTUN
□	30	.4	.05	.095	248
▽	30	.4	.05	.076	248

ALTERNATING ROOT TORSION TB12
 VERSUS
 LATERAL CYCLIC

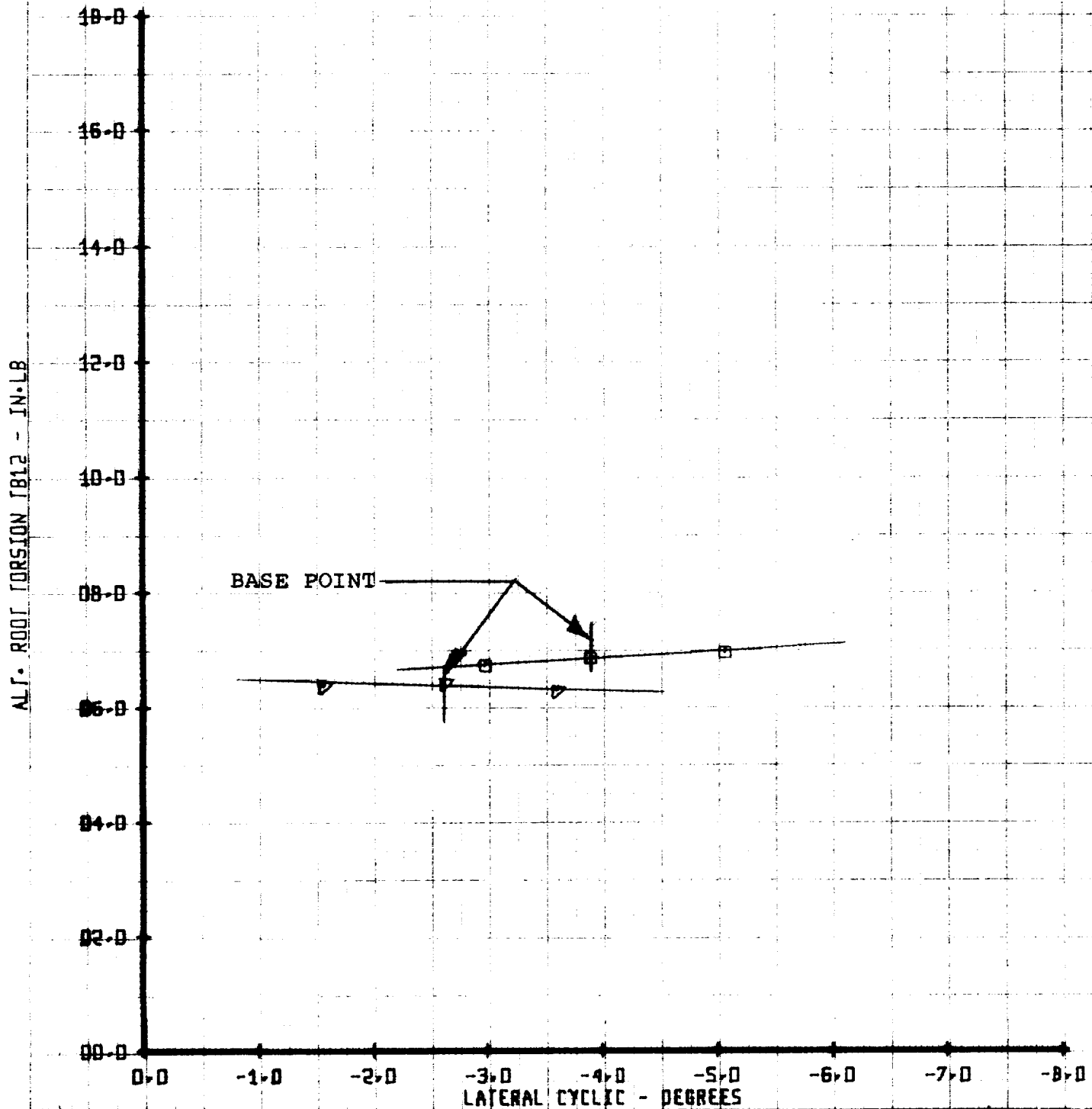


Figure C-31

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-42B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/OD258	CT'/58	VTUN	$\Delta C_{L'}/\Delta \delta$
+	25	.10	.05	.124	62	-.00175
+	28	.20	.05	.123	124	-.00335
+	30	.40	.05	.095	248	-.00435

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

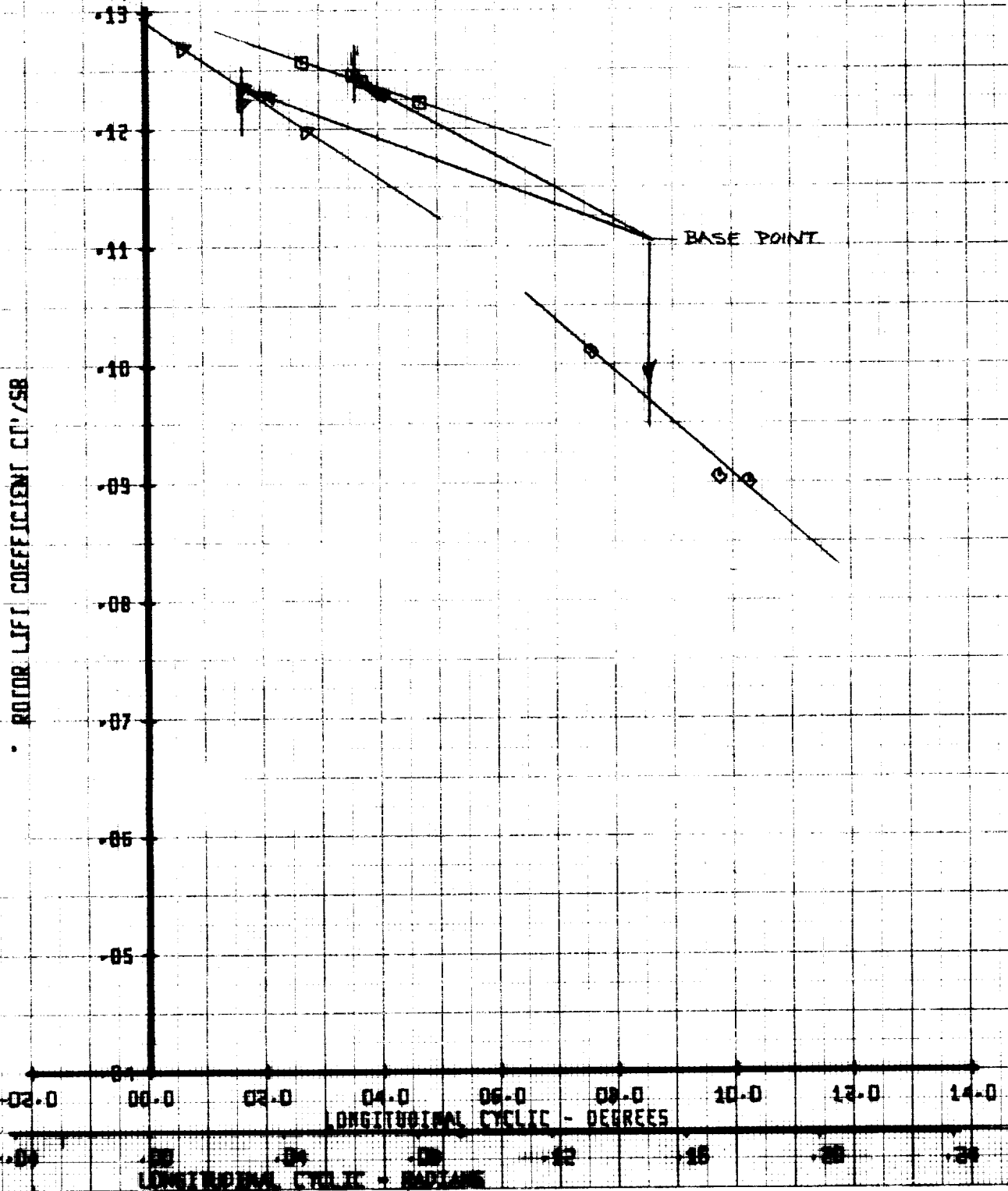


Figure C-32

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/100758	CT/98	VTUN	ΔC _x /ΔC _z
00	25	.10	.05	.124	62	.00197
01	28	.20	.05	.123	124	.00218
02	30	.40	.05	.095	248	.00141

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

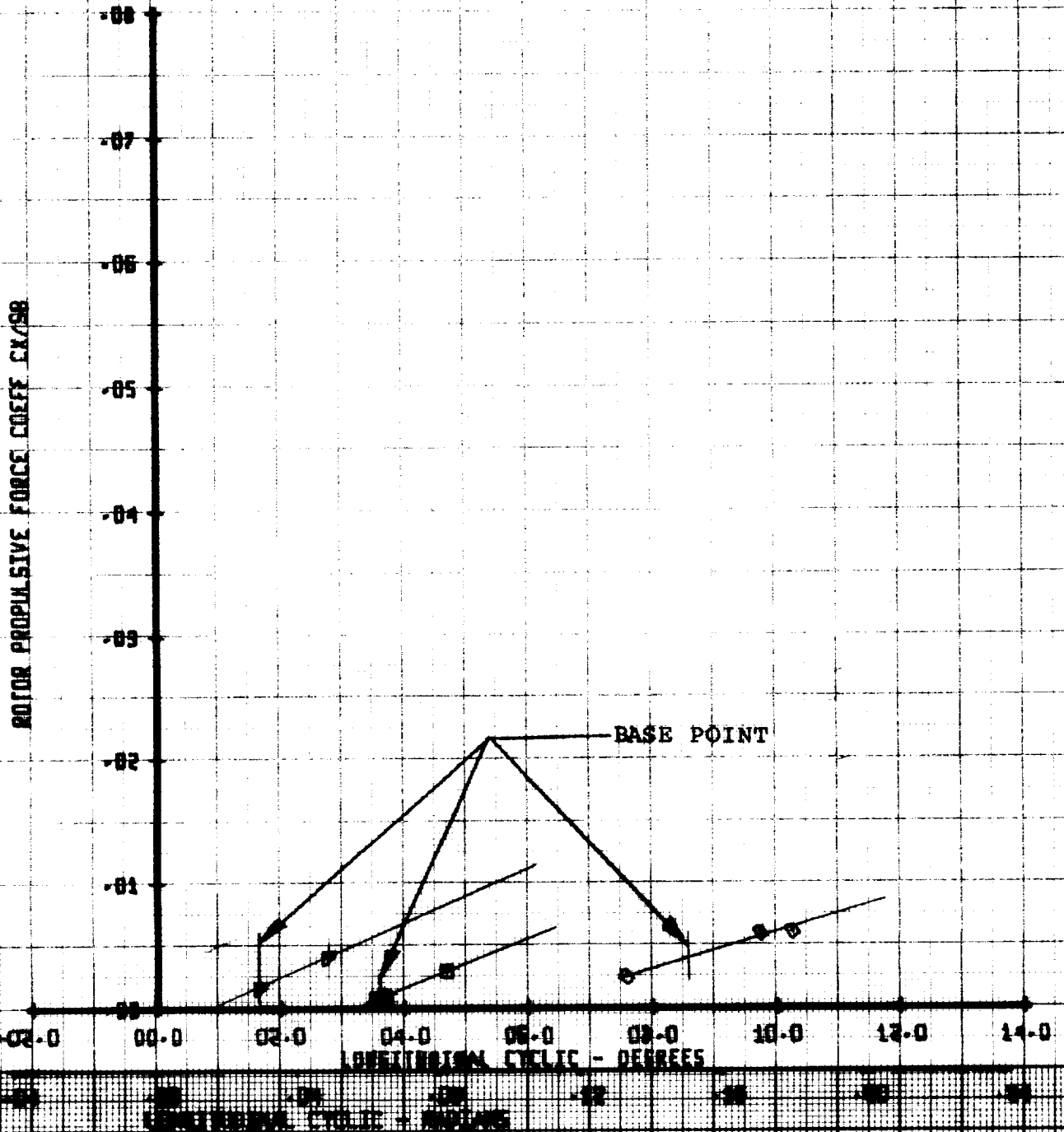


Figure C-33

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/CD258	CT'/58	VTUN	$\Delta C_p/6/4B$
□	25	.10	.05	.124	62	.000060
△	28	.20	.05	.123	124	.000245
◆	30	.40	.05	.095	248	.000062

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

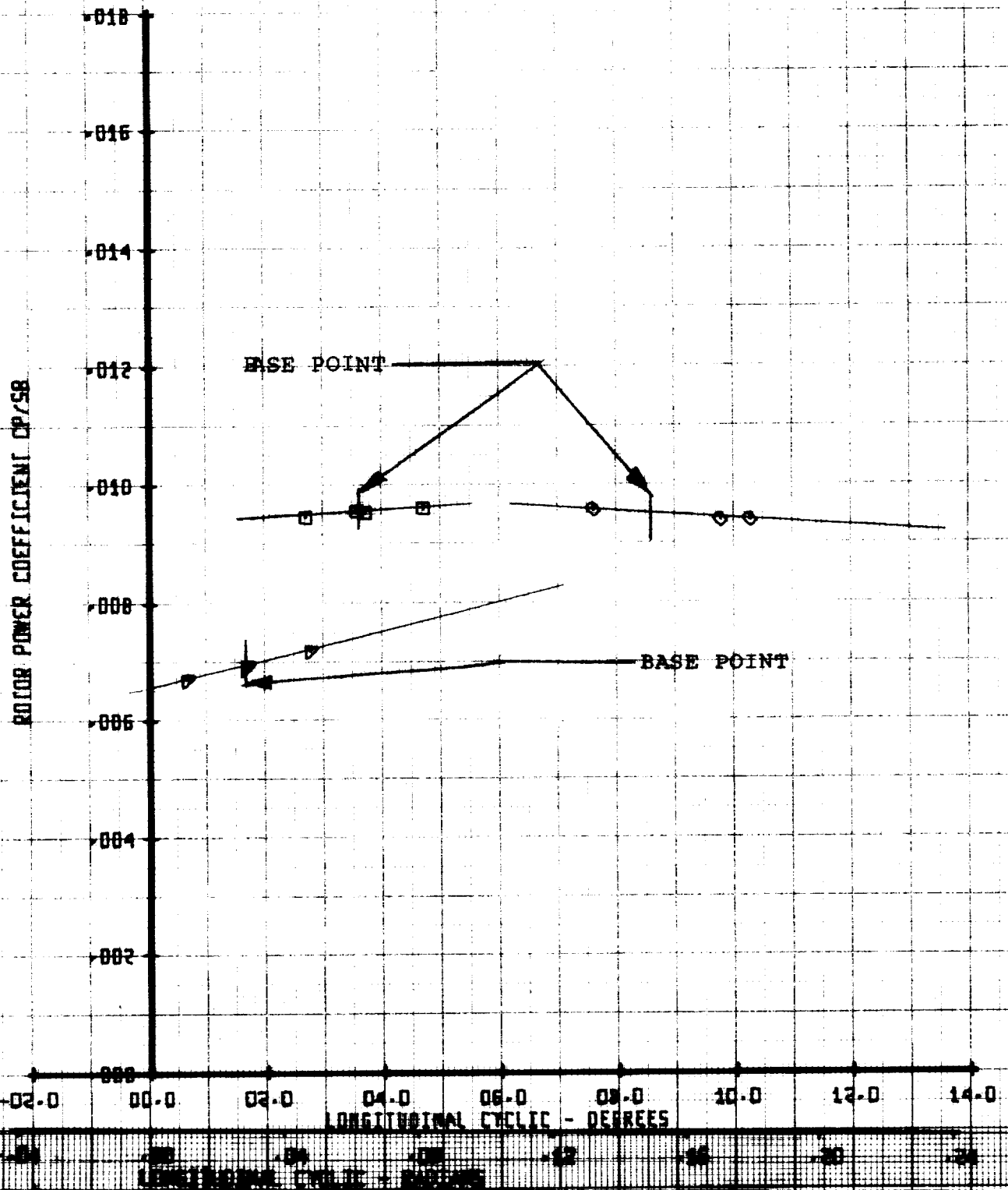


Figure C-34

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/SB	VTUN	ΔCPM/AB
□	25	.10	.05	.124	62	-.000043
◻	28	.20	.05	.123	124	-.000064
◇	30	.40	.05	.095	248	-.000075

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

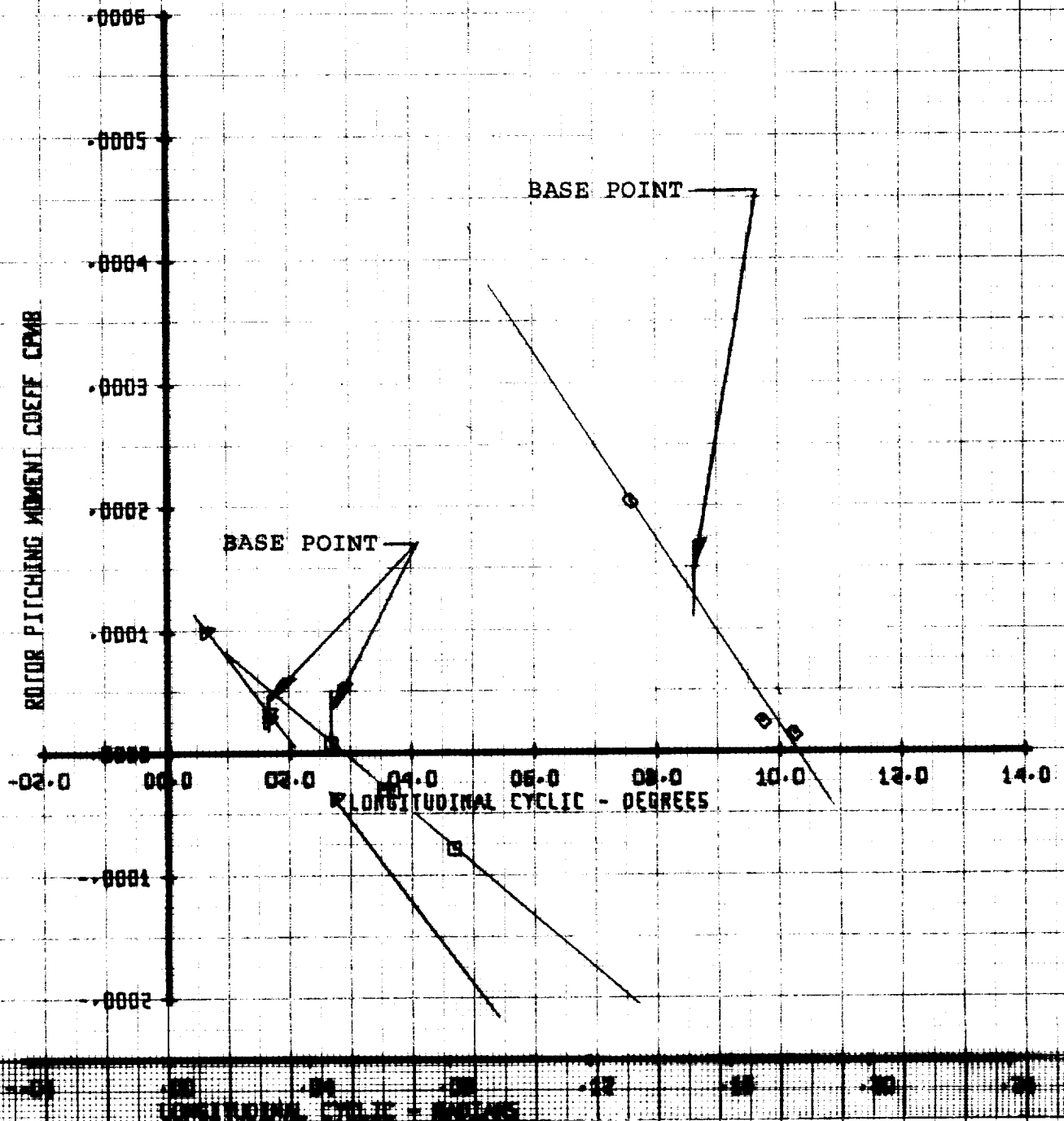


Figure C-35

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

S/N	RUN	MU'	X/1000	CT'/98	VTUN	ΔCRM/ΔB
8	25	.10	.05	.124	62	.0000263
9	28	.20	.05	.123	124	.0000337
10	30	.40	.05	.095	248	.0000298

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

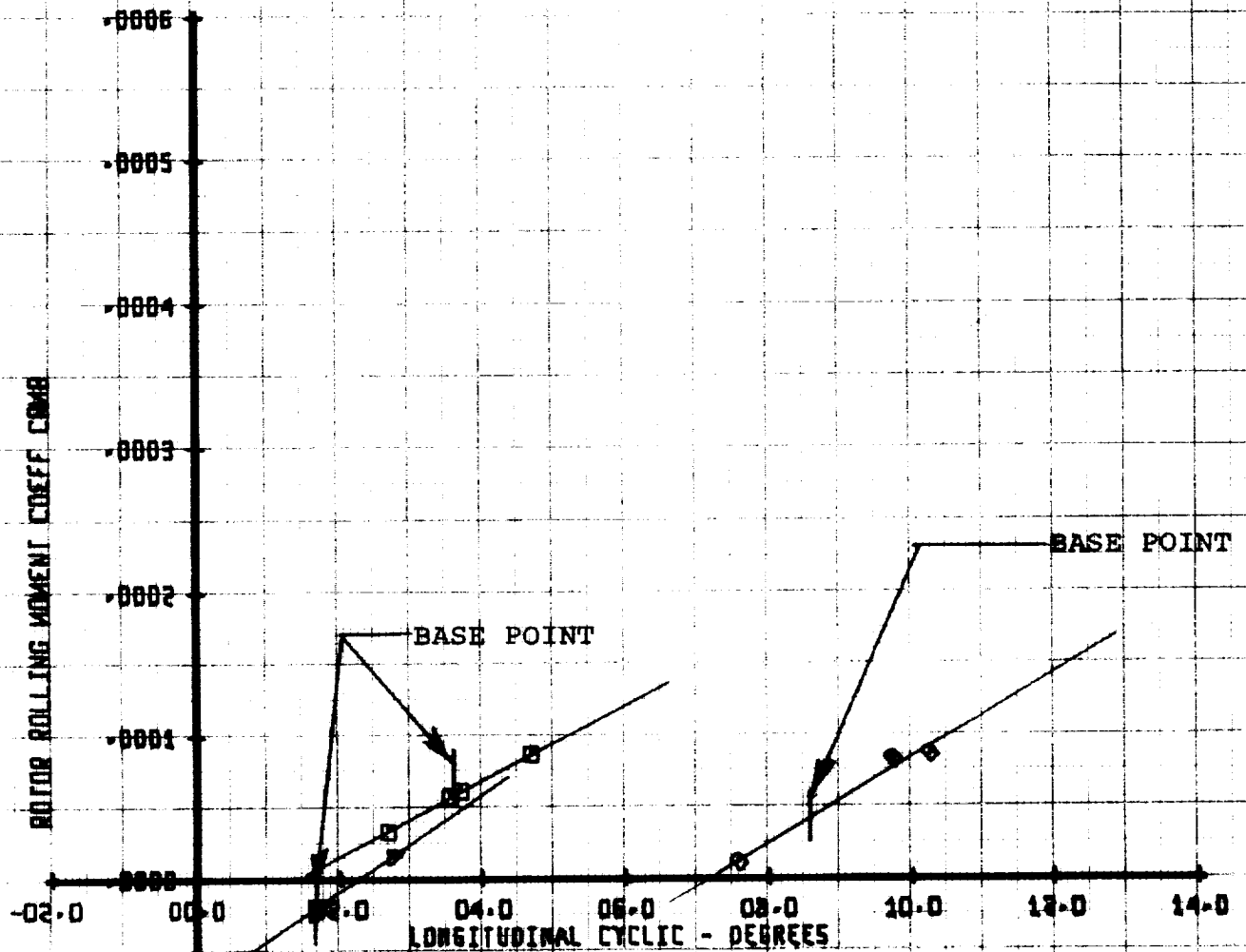


Figure C-36

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/58	VTUN	ACH/5/AB
◇	25	.10	.05	.124	62	-.00199
◇	28	.20	.05	.123	124	-.00242
◇	30	.40	.05	.095	248	-.00177

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

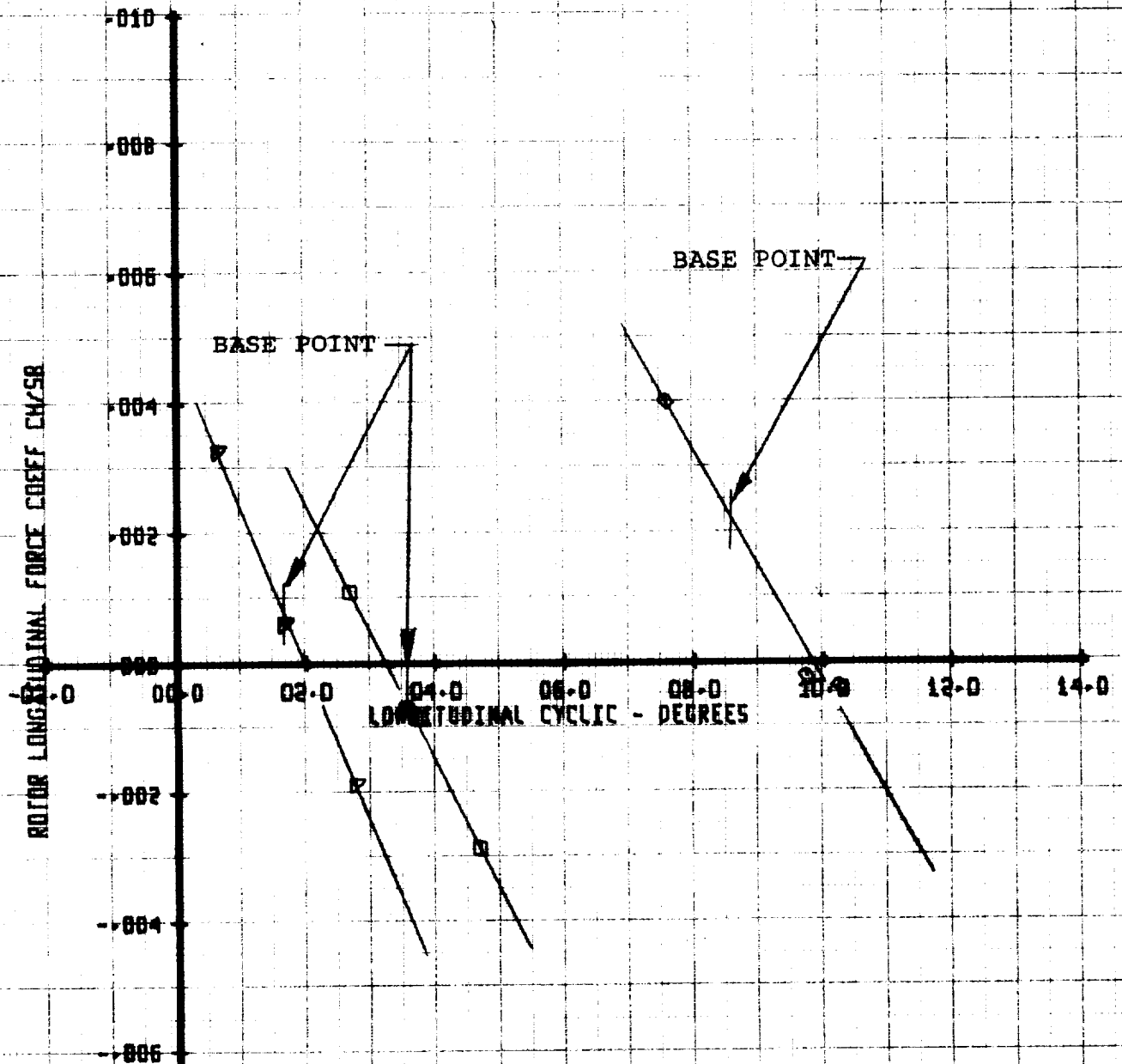


Figure C-37

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/SB	VTUN	ΔCSE/ΔBI
□	25	.10	.05	.124	62	.00061
△	28	.20	.05	.123	124	.00096
◇	30	.40	.05	.095	248	.00072

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

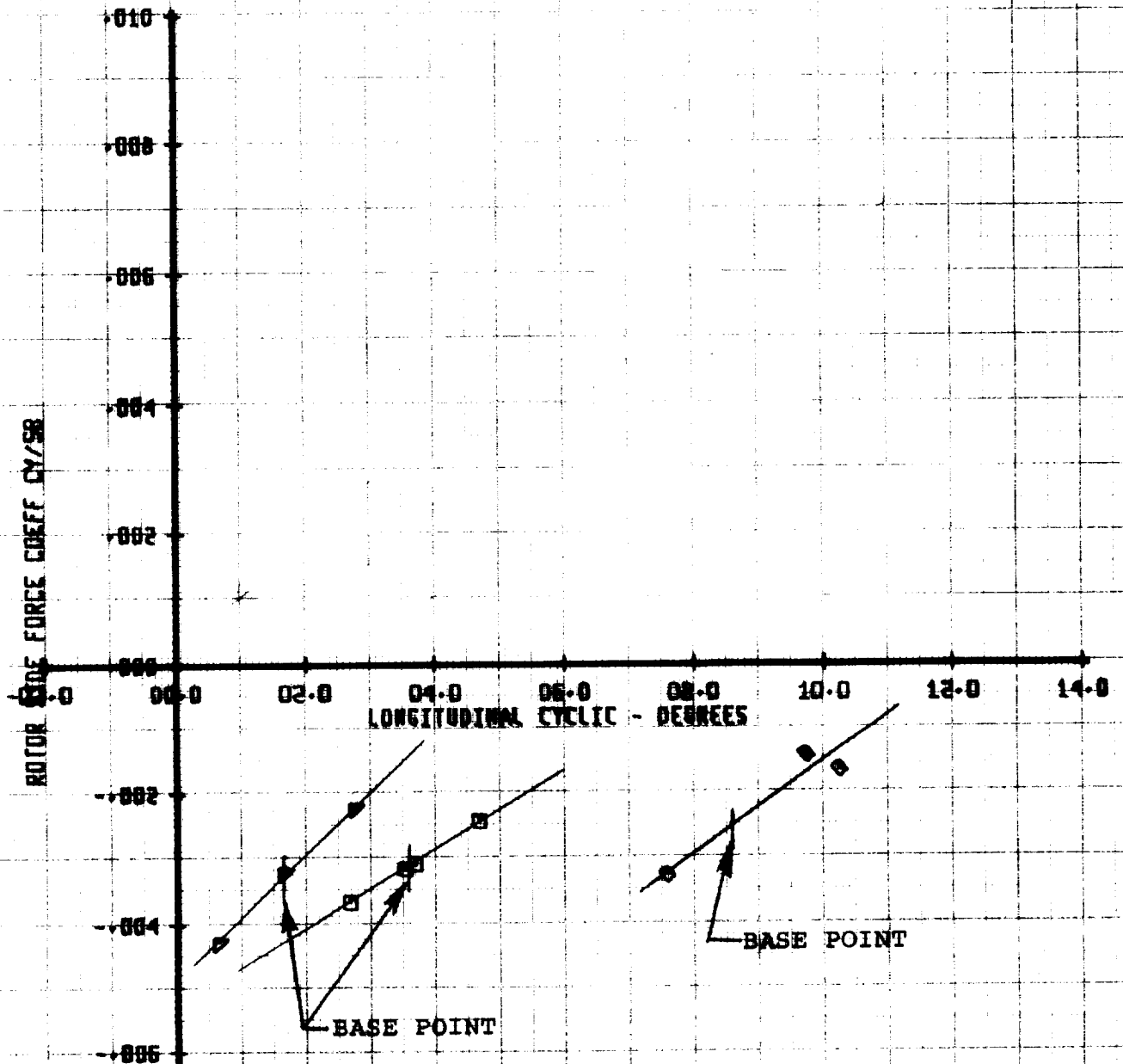


Figure C-38

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE OH-478 ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/SB	VTUN	$\Delta FB_{12}/\Delta B$
□	25	.10	.05	.124	62	4.02
△	28	.20	.05	.123	124	-1.10
◇	30	.40	.05	.095	248	-0.30

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC

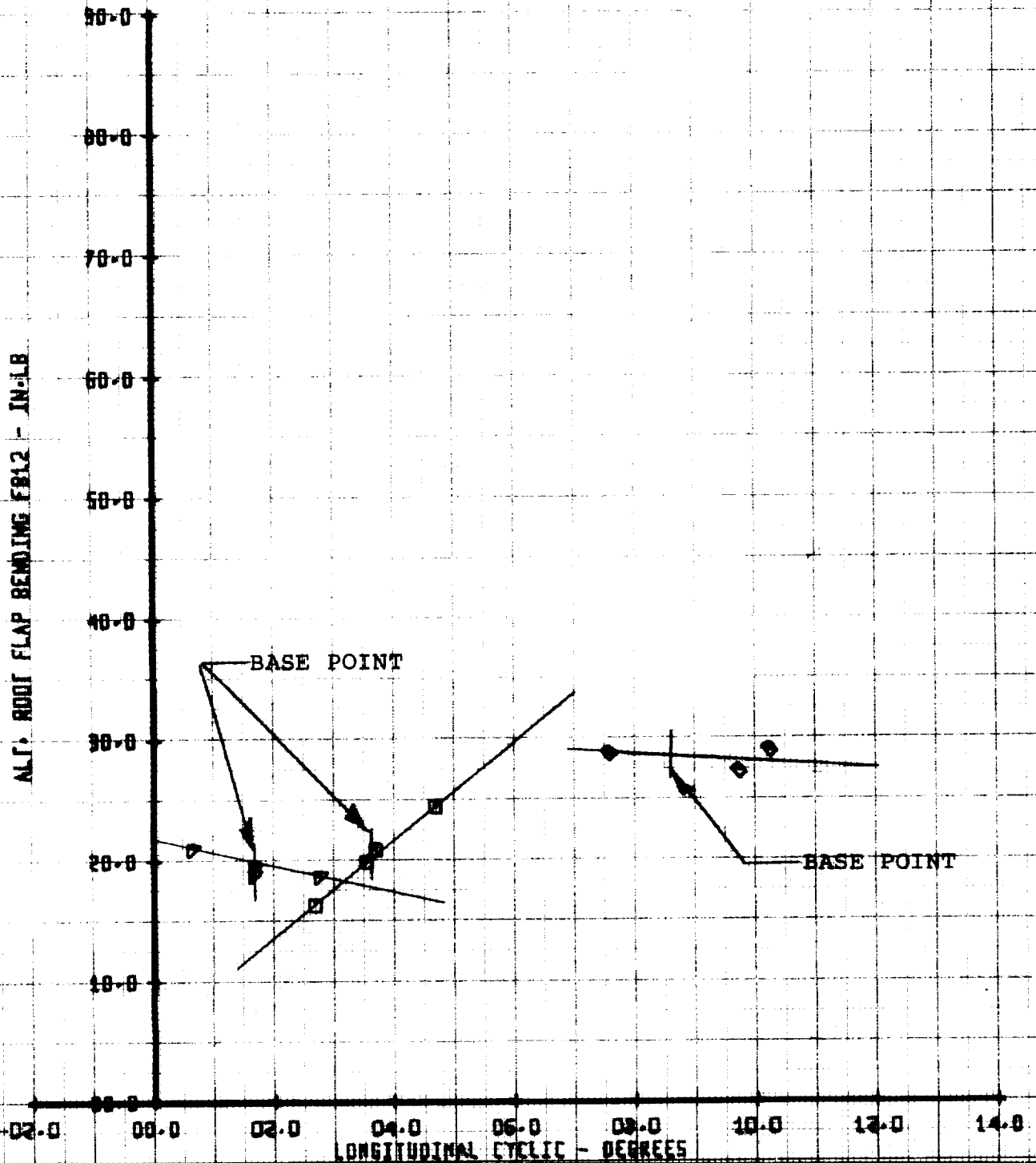


Figure C-39

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD2SB	CT'/SB	VTUN	ACTIL/AT
□	25	.10	.05	.124	62	0.76
△	28	.20	.05	.123	124	3.38
◇	30	.40	.05	.095	248	2.36

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LONGITUDINAL CYCLIC

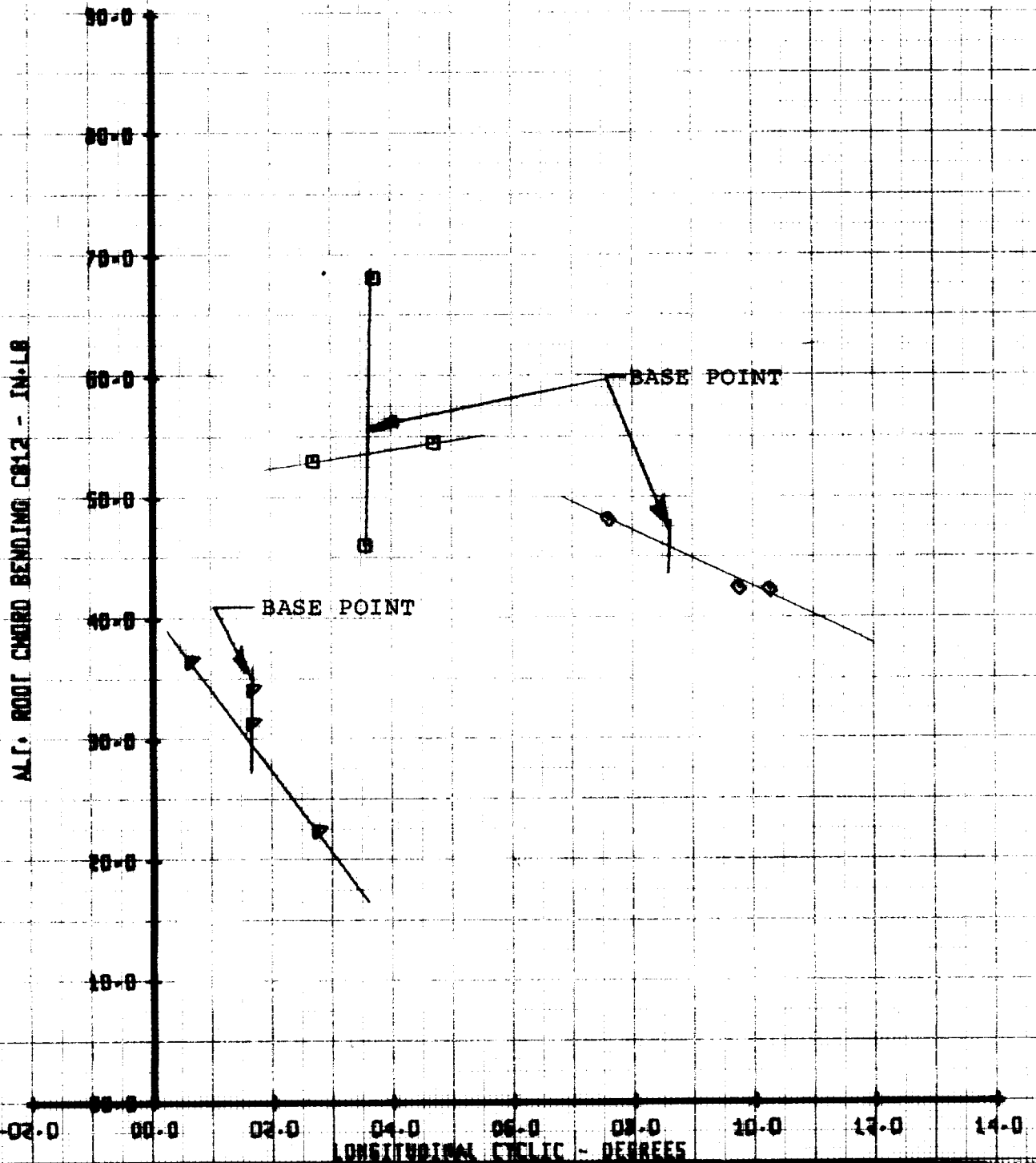


Figure C-40

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/OD258	CT/58	VTUN	
090	25	.10	.05	.124	62	.08
090	28	.20	.05	.123	124	.215
090	30	.40	.05	.095	248	.201

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC

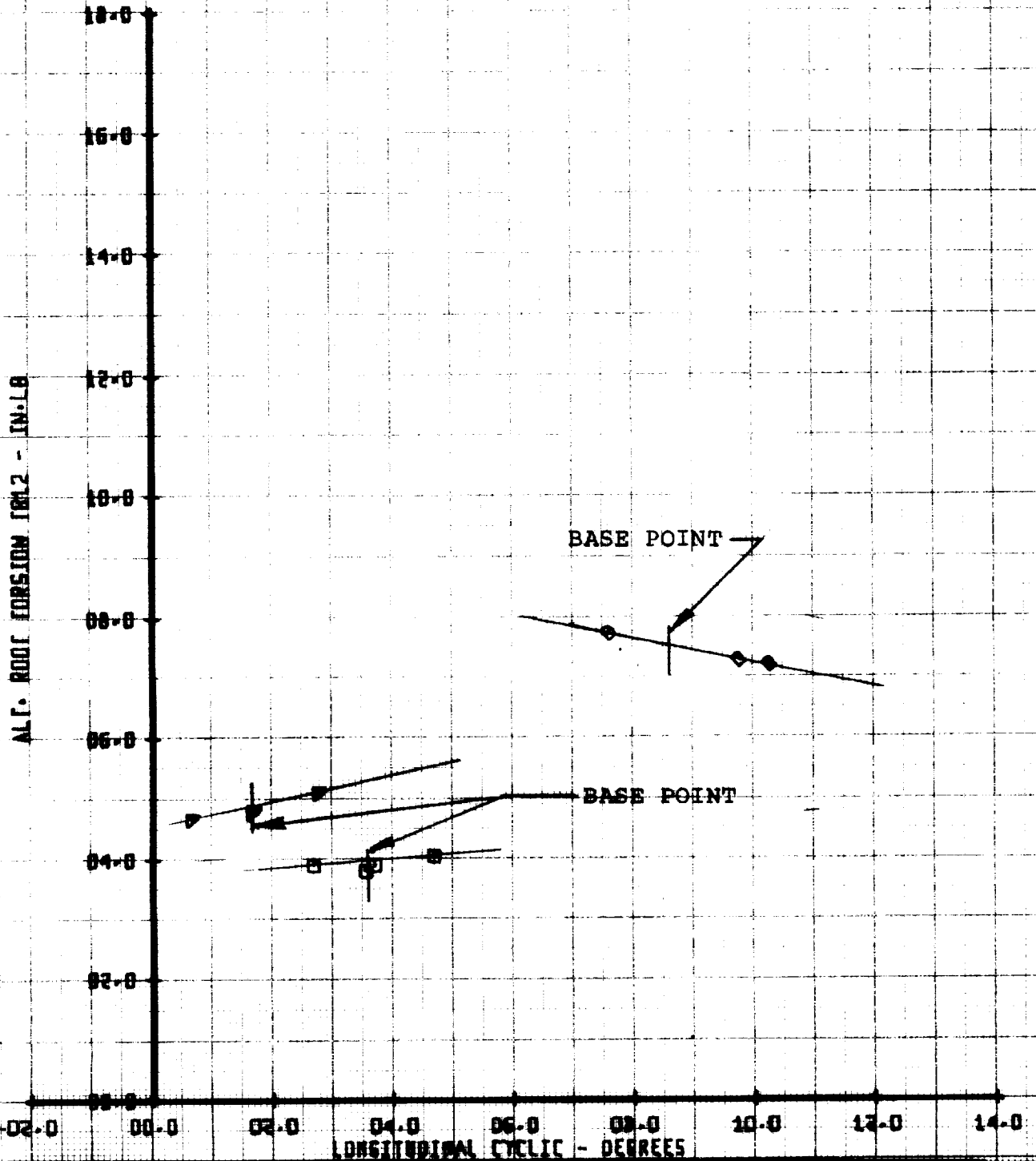


Figure C-41

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SMA	RUN	MU	X/CD258	CT/58	VIUN	AC/14/AB
90	28	.20	.05	.123	124	.0068
90	28	.20	.05	.090	124	.0065

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

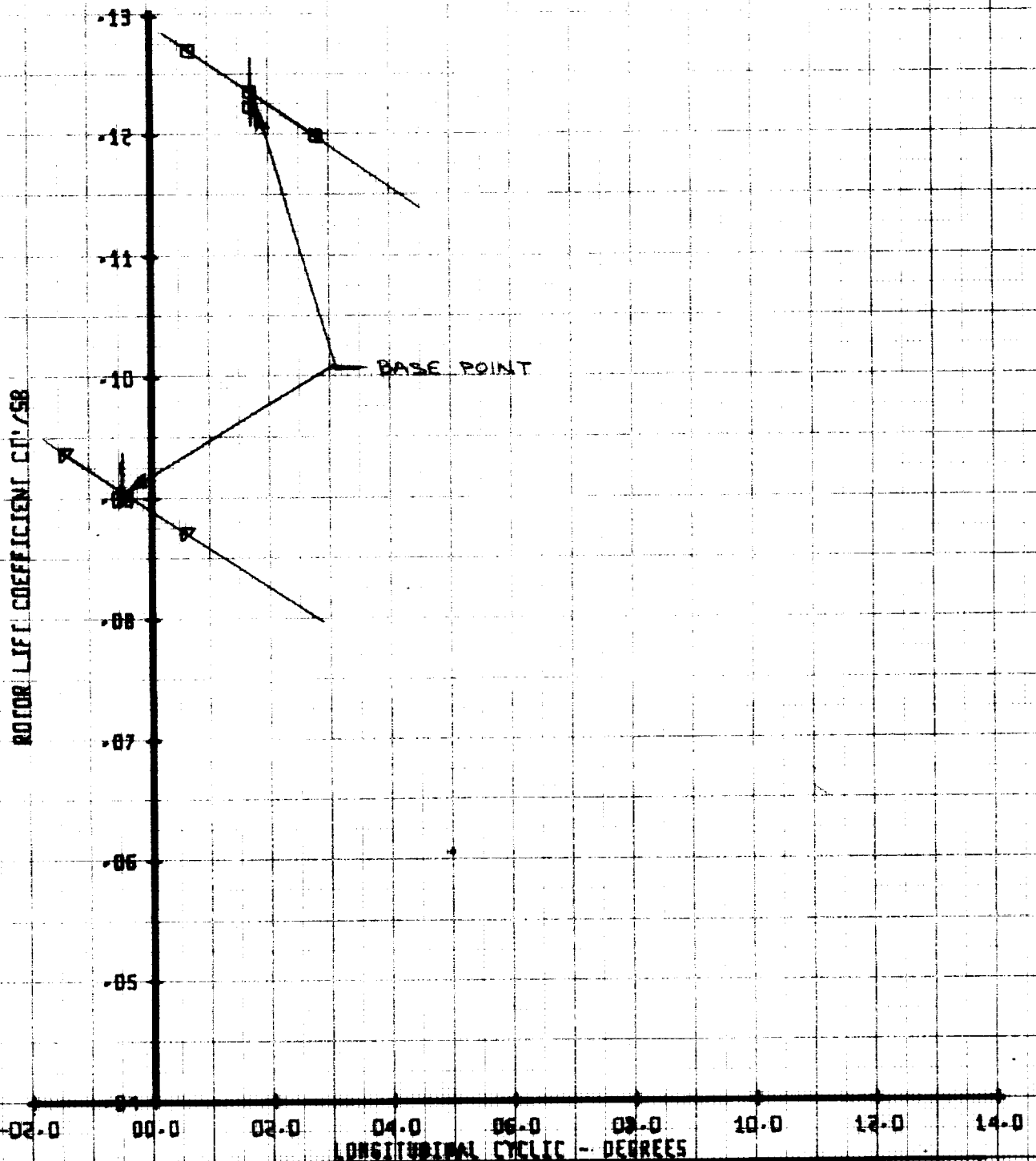


Figure C-42

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU' X/00258	CT' / 98	VTUN
0	28	.20	.05	.123
9	28	.20	.05	.090

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

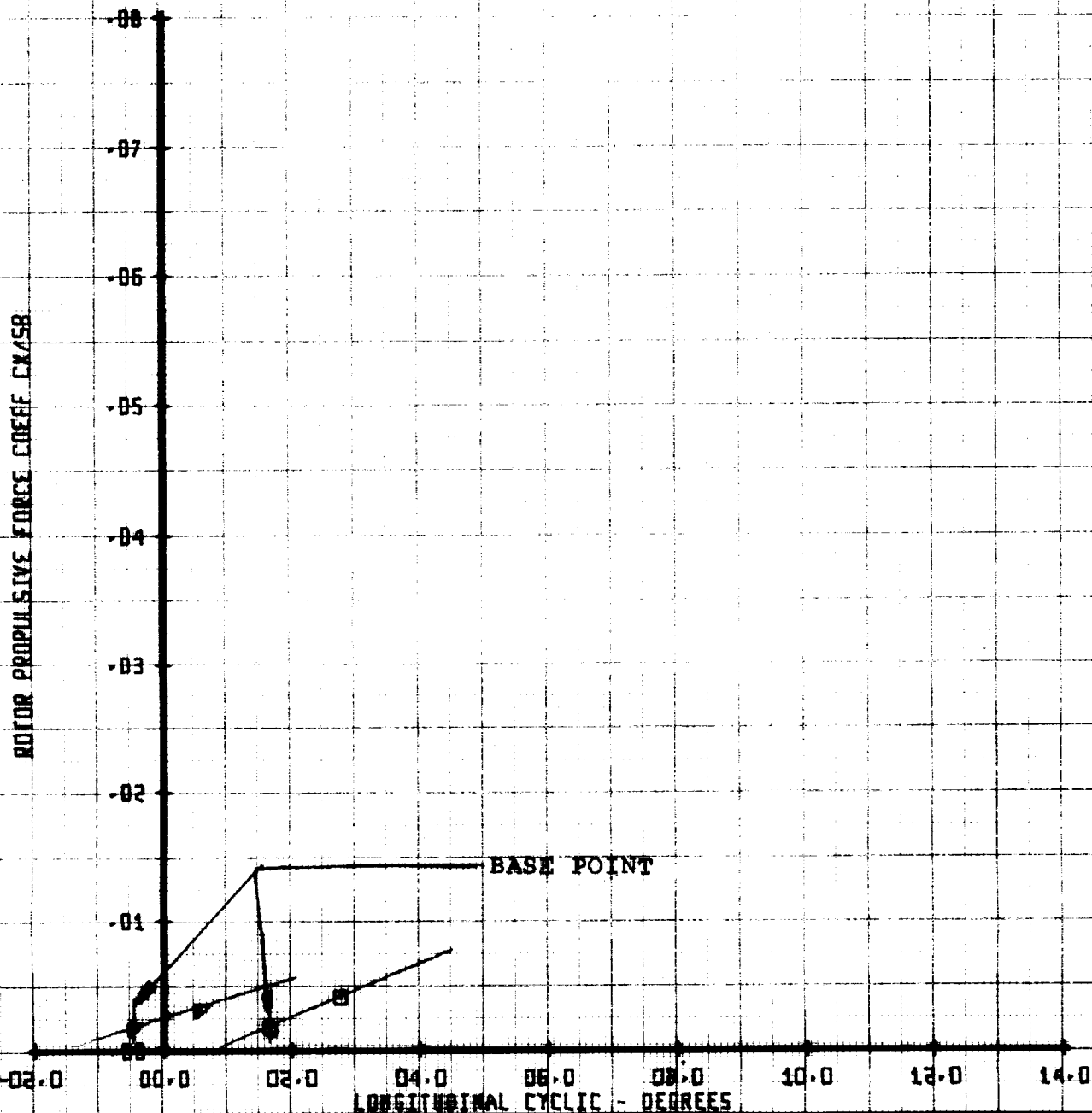


Figure C-43

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SIM	RUN	MU	X/00258	CT/58	VTUN	ΔC_{dAB}
0	28	.20	.05	.123	124	.00022
4	28	.20	.05	.090	124	.00025

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

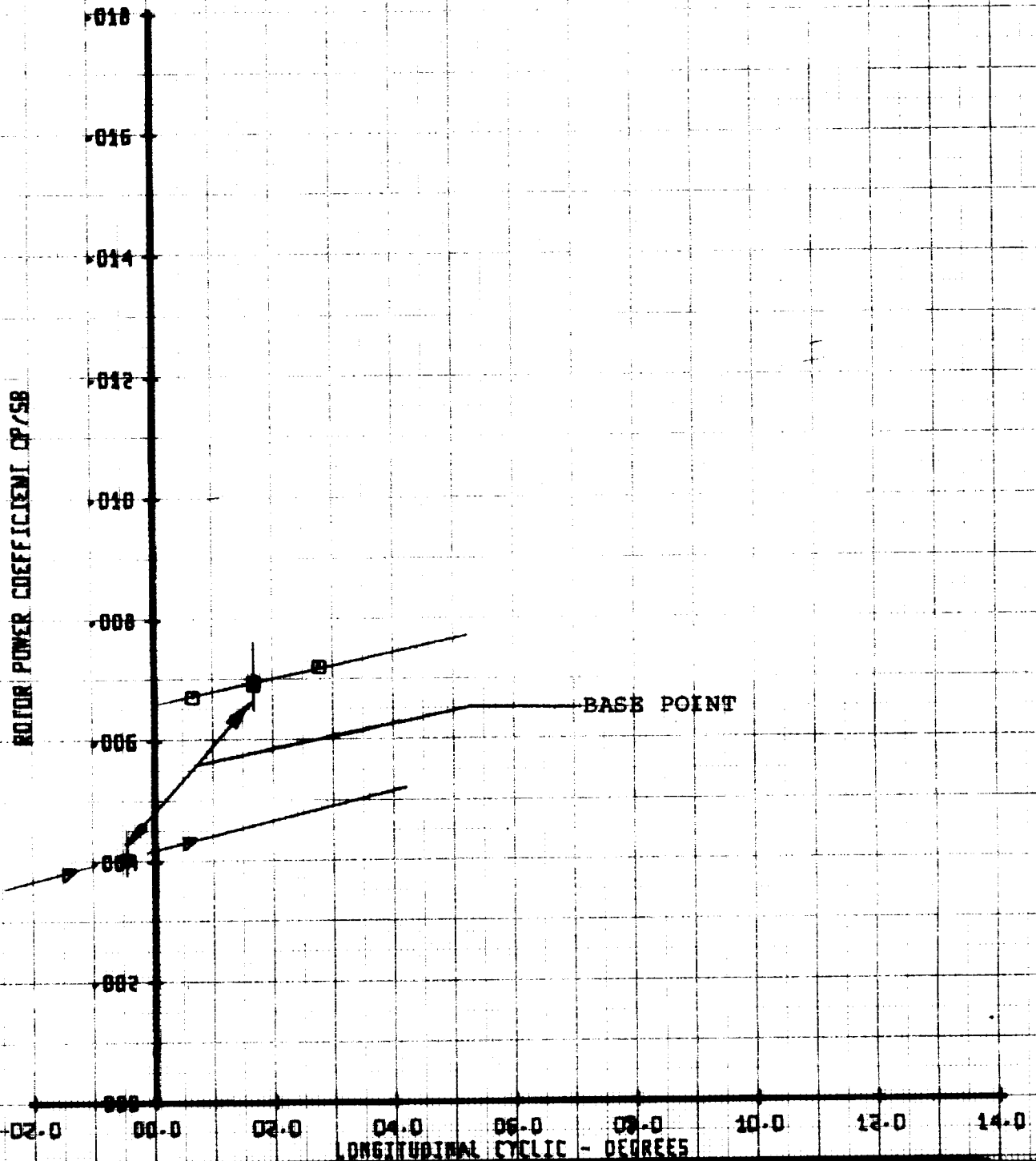


Figure C-44

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/50	VTUN	
90	28	.20	.05	.123	124	.000063
90	28	.20	.05	.090	124	.000066

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

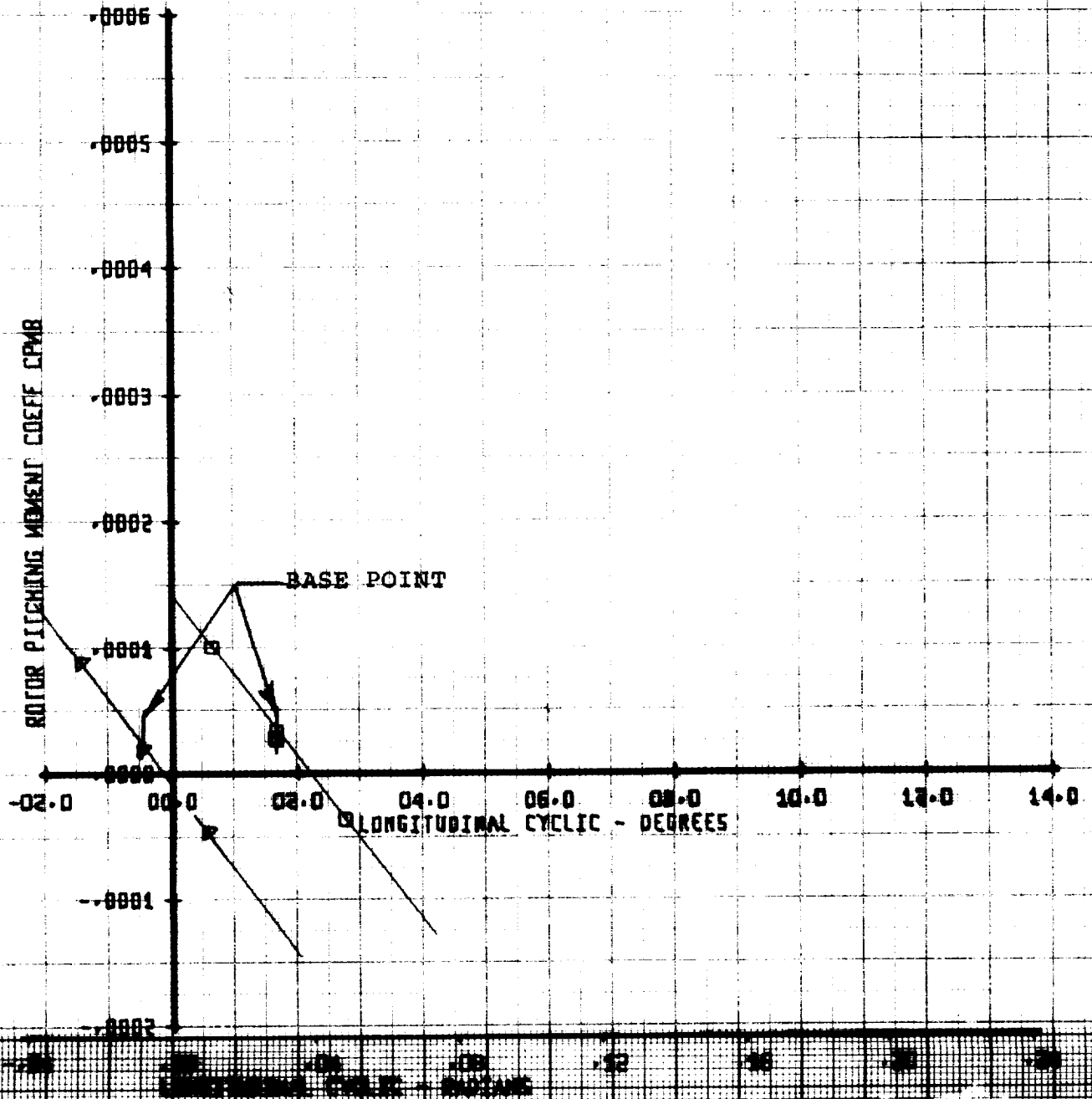


Figure C-45

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD2SB	CT'/SB	VTUN	
0	2B	.20	.05	.123	124	.000033
1	2B	.20	.05	.090	124	.000086

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

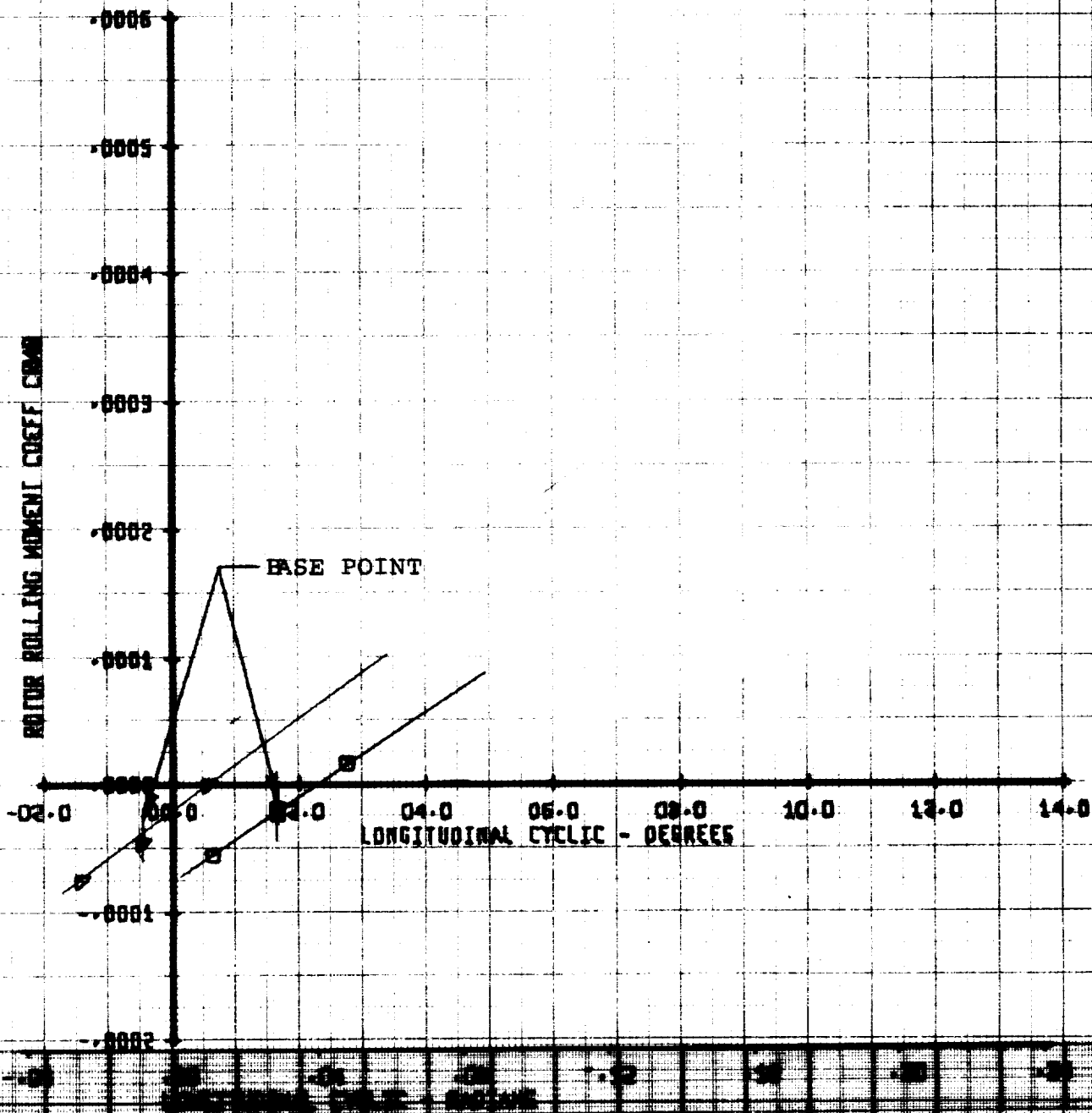


Figure C-46

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/98	VTUN	
AB	2B	.20	.05	.123	124	.00244
AB	2B	.20	.05	.090	124	

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

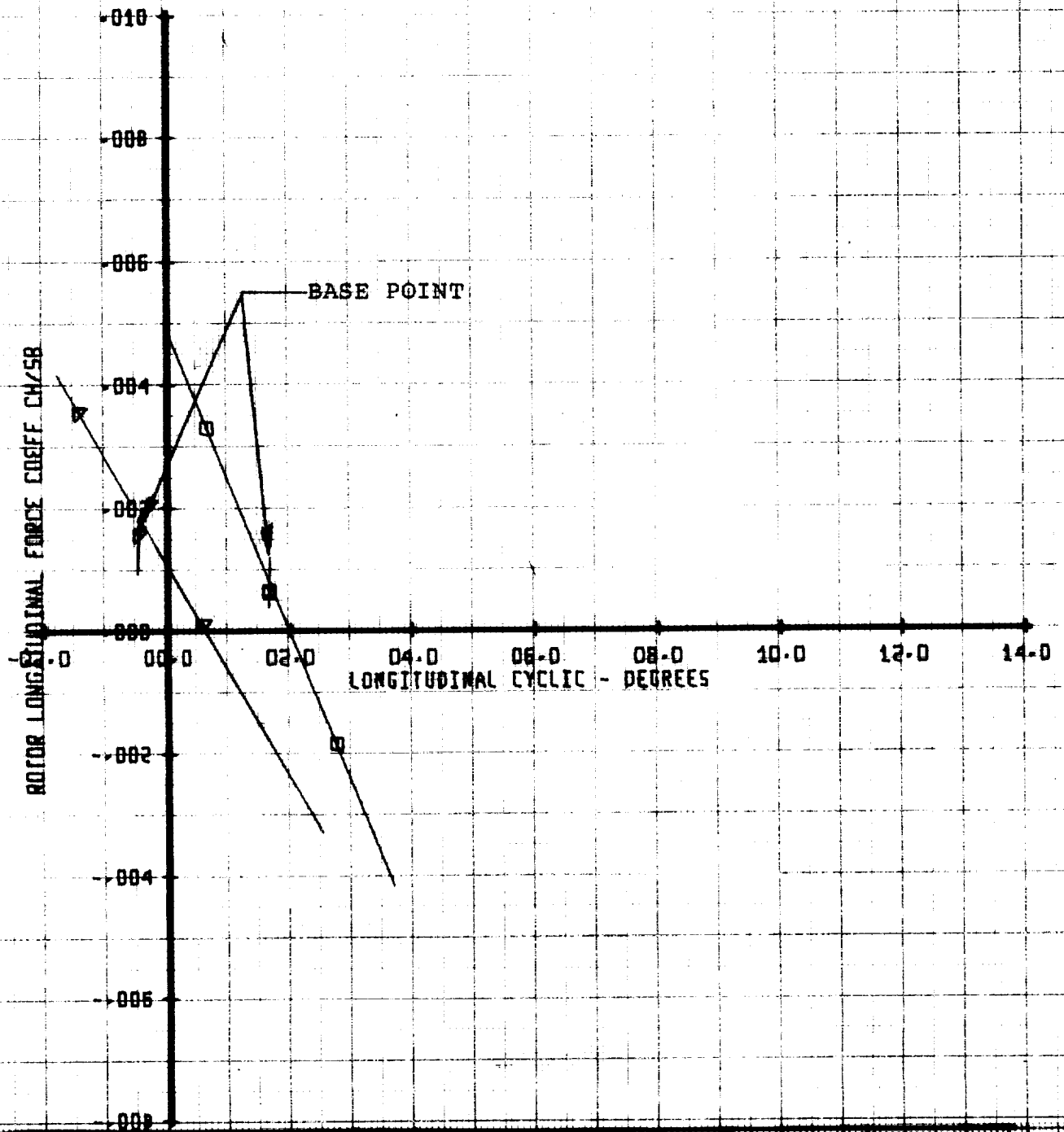


Figure C-47

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE OH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/OD258	CT'/58	VTUN
B	28	.20	.05	.123	124
A	28	.20	.05	.090	124

ROTOR SIDE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

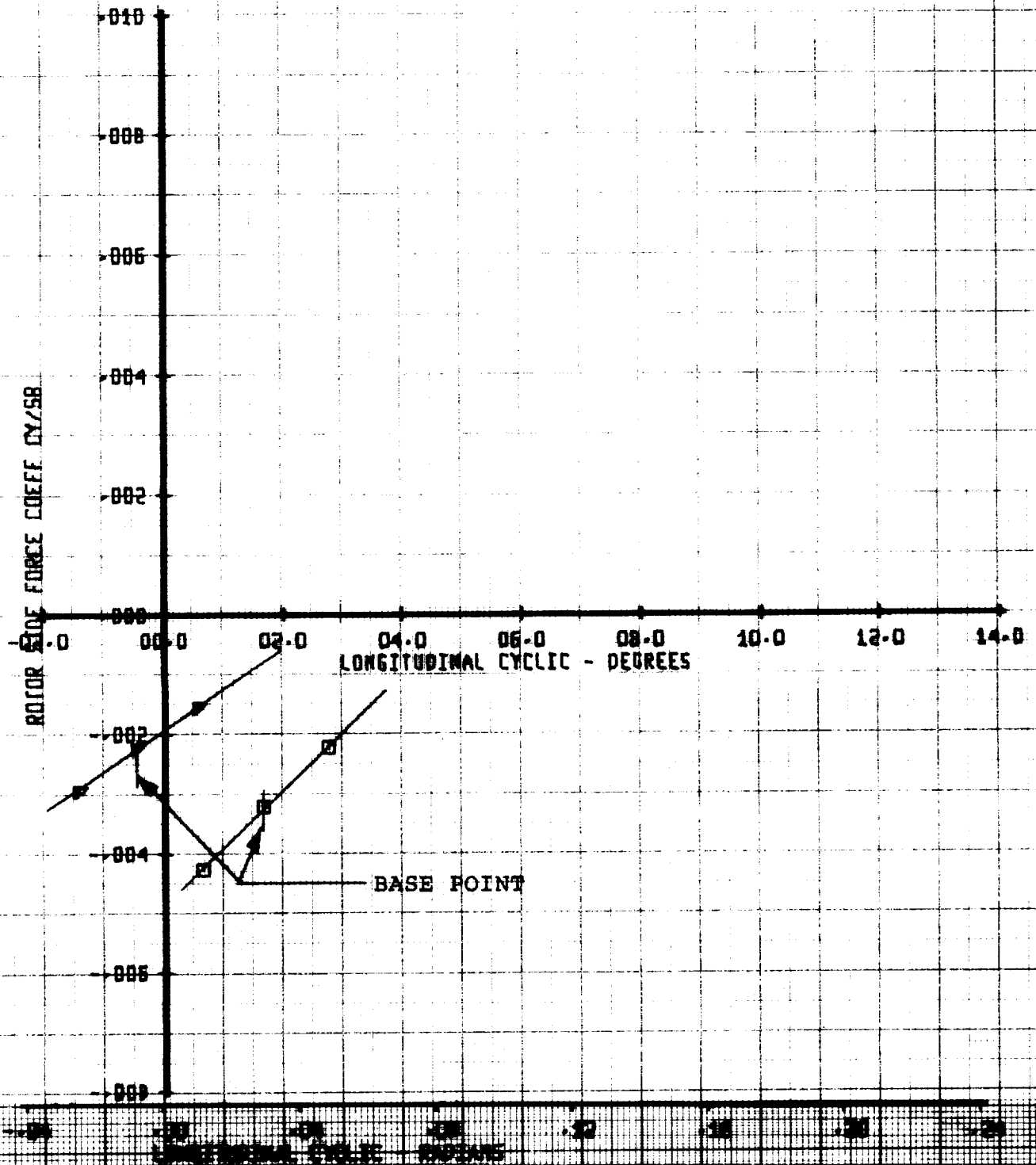


Figure C-48

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD2SB	CT'/SB	VTUN
28	28	.20	.05	.123	124
4	28	.20	.05	.090	124

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC

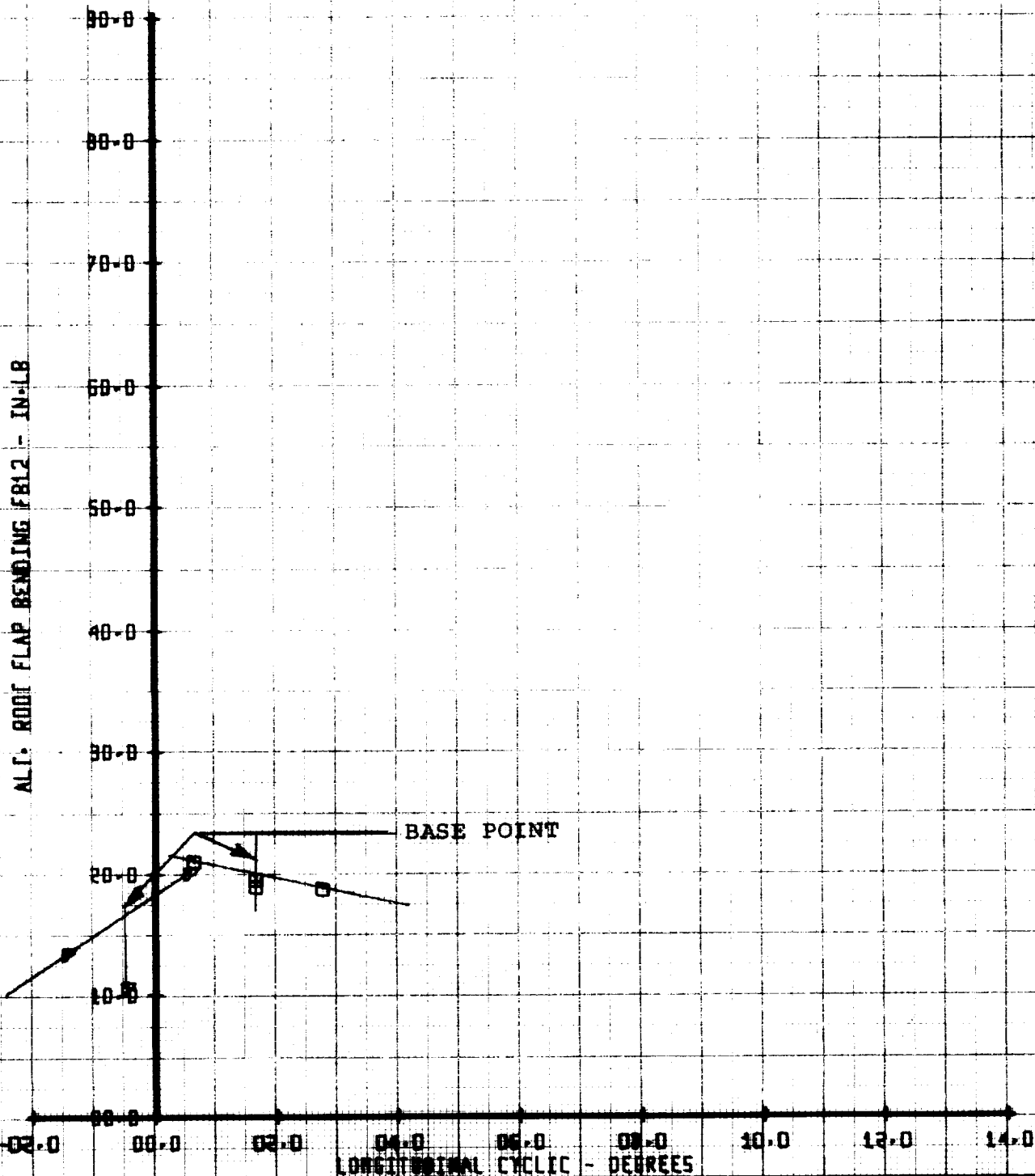


Figure C-49

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-42B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML' X/00258	CT'/98	VTUN
8	28	.20	.05	.123
9	28	.20	.05	.090

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LONGITUDINAL CYCLIC

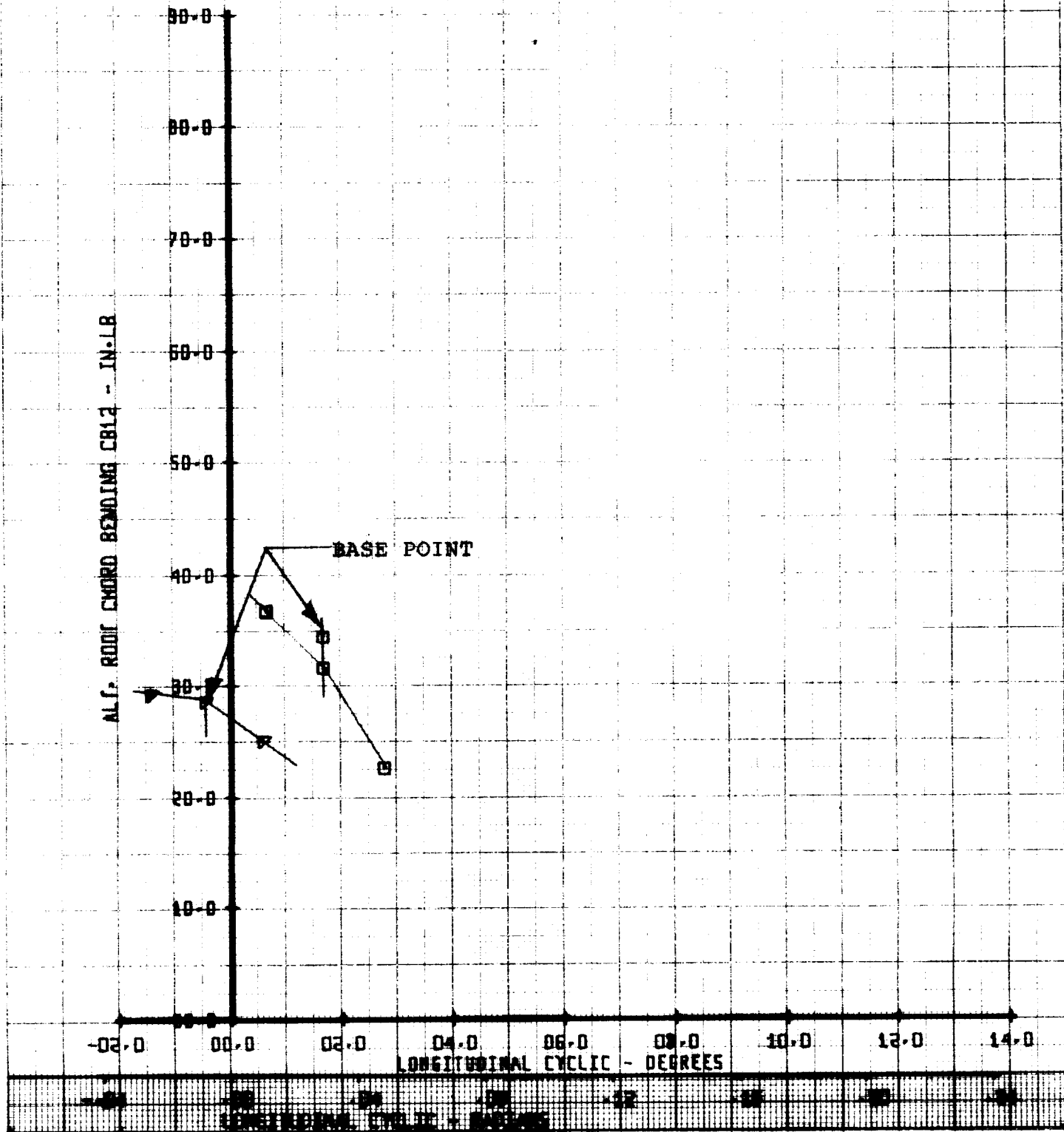


Figure C-50

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD2SB	CT'/SB	VIUN
Q	28	.20	.05	.123	124
P	28	.20	.05	.090	124

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC

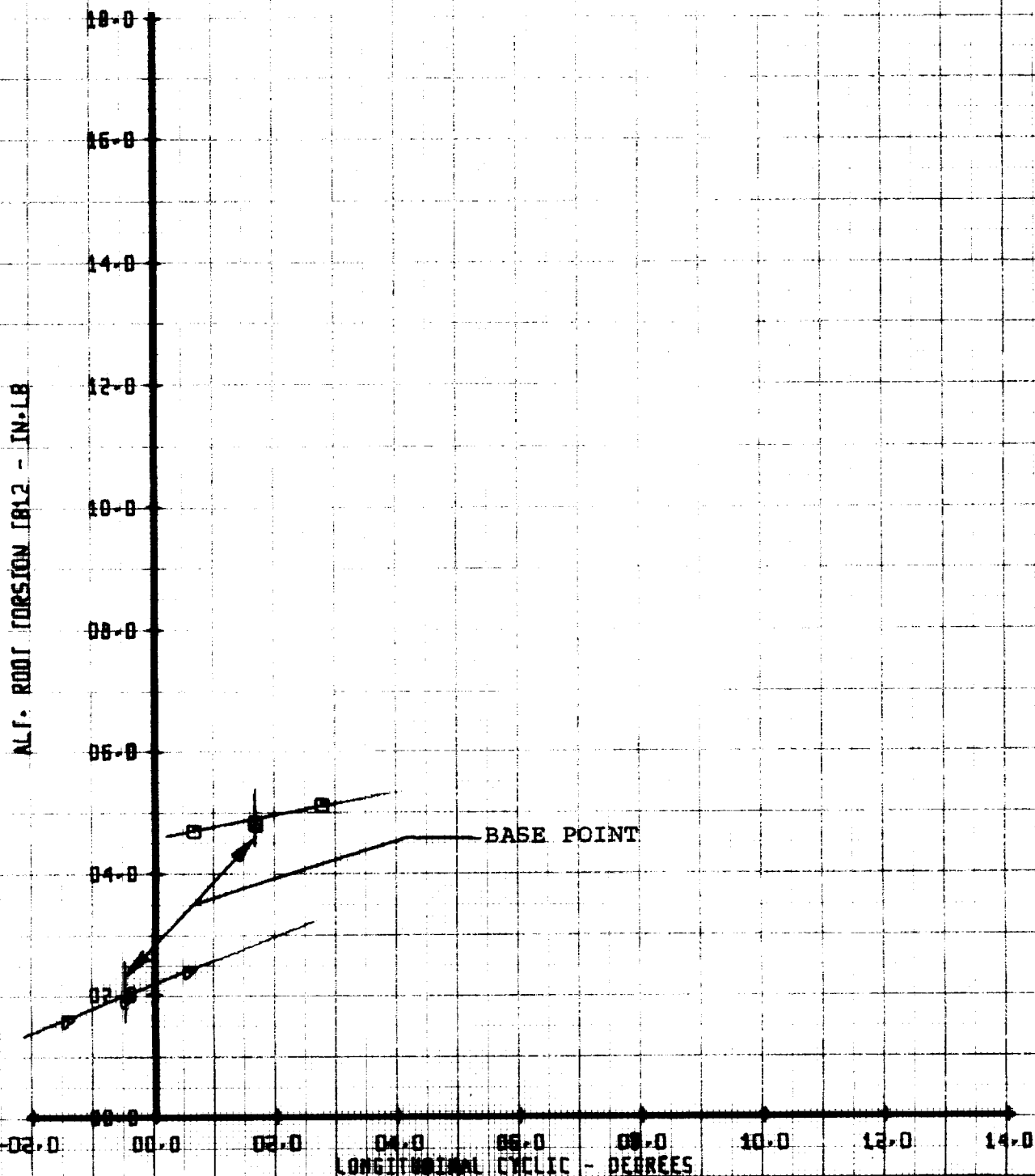


Figure C-51

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-42B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD2SB	CT'/SB	VIUN
0	30	.40	.05	.095	248
1	30	.40	.05	.076	248

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

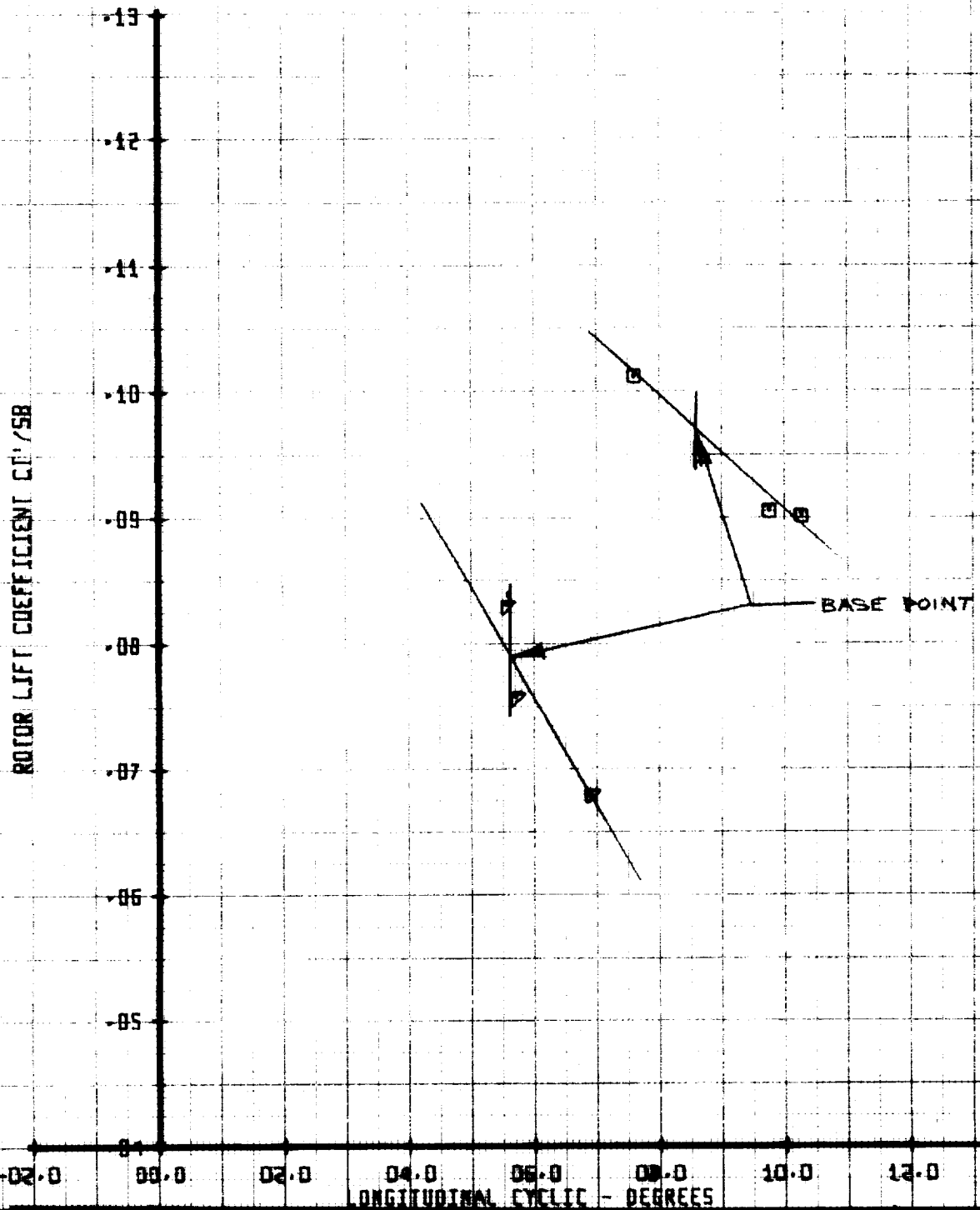


Figure C-52

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	30	.40	.05	.095	248
▽	30	.40	.05	.076	248

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

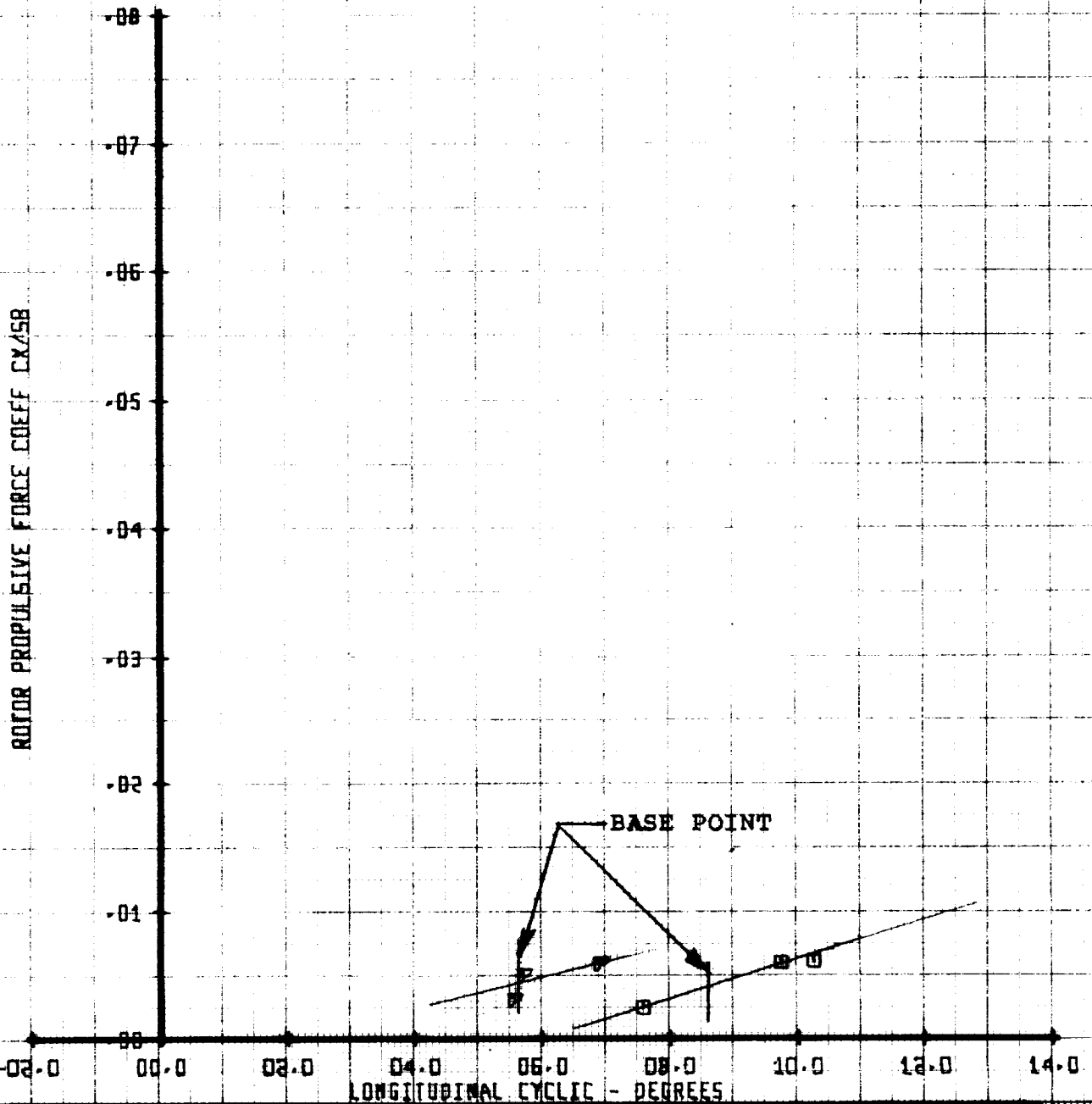


Figure C-53

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-42B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/CD258	CT/58	VTUN
0	30	.40	.05	.095	248
7	30	.40	.05	.076	248

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

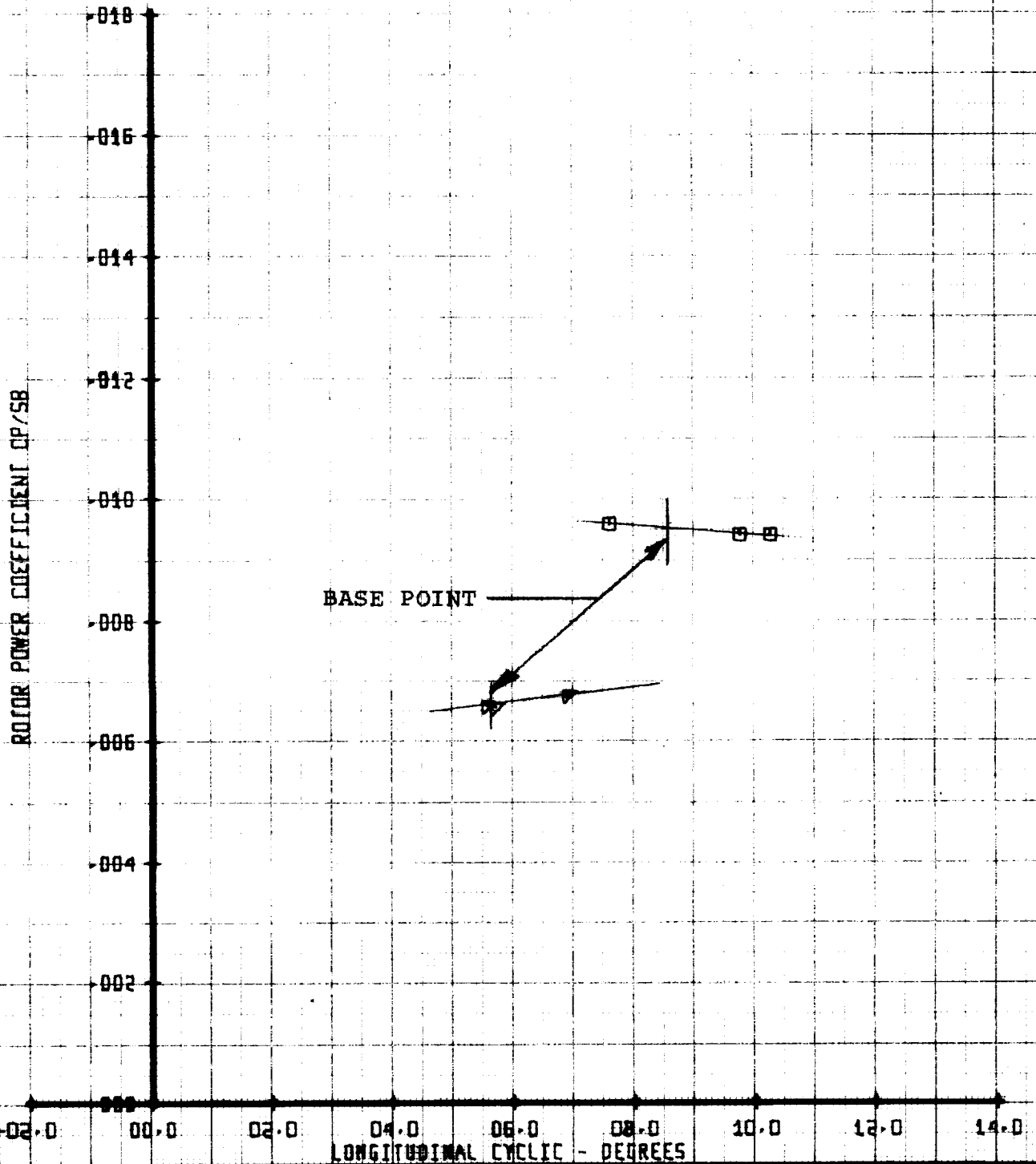


Figure C-54

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CI'/58	VTUN
□	30	.40	.05	.095	248
△	30	.40	.05	.076	248

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

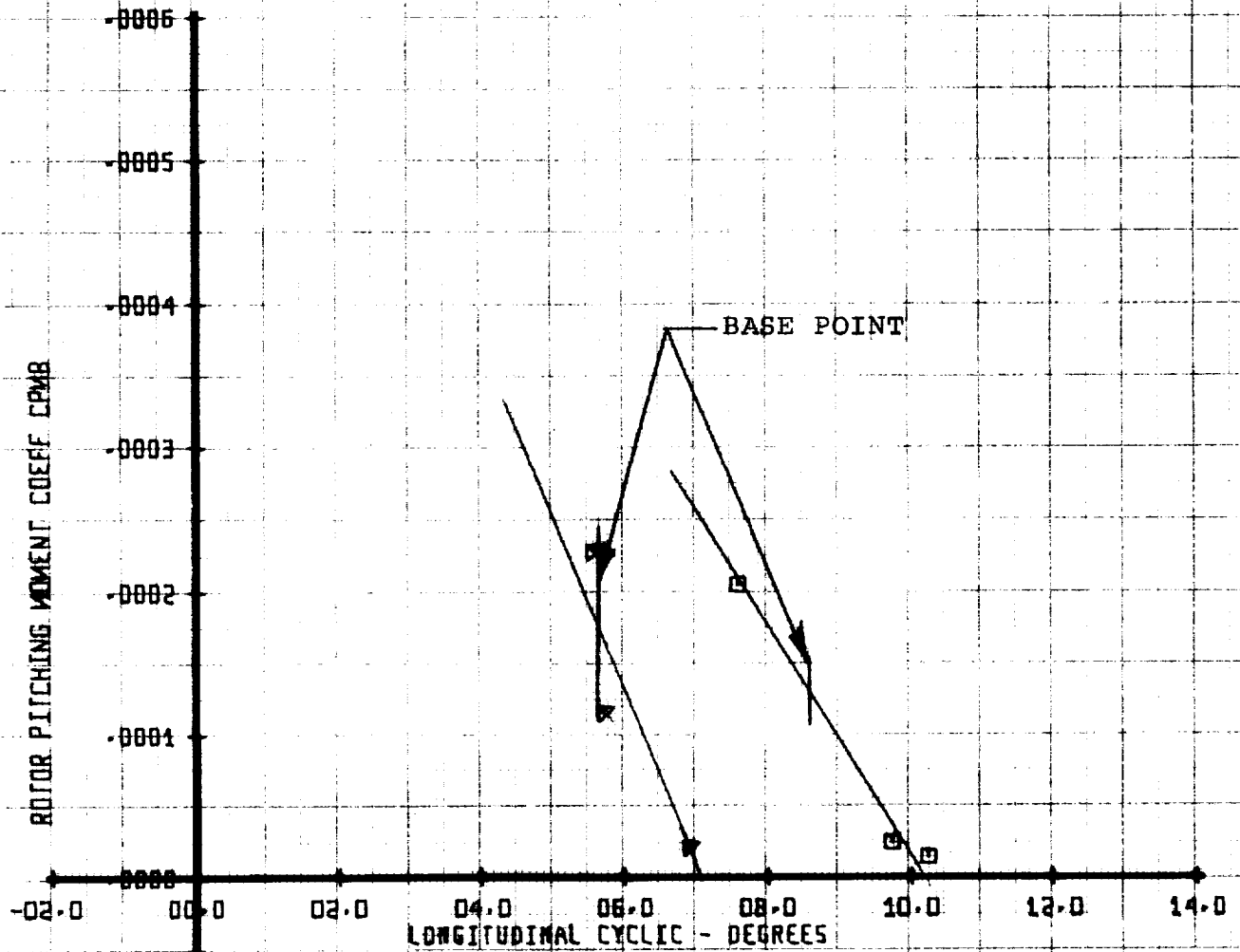


Figure C-55

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-42B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/OD2SB	CT'/SB	VTUN
□	30	.40	.05	.095	248
▽	30	.40	.05	.076	248

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

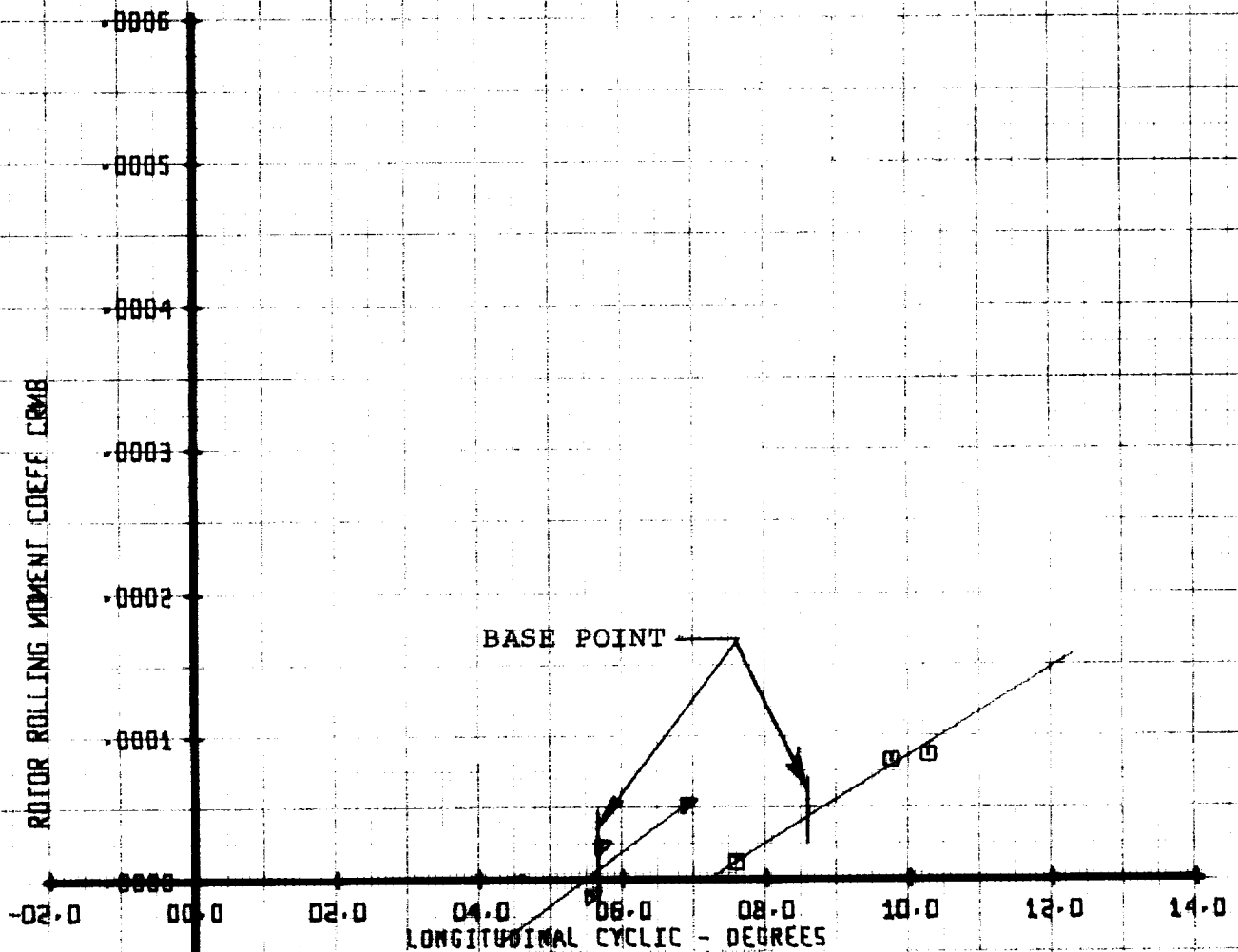


Figure C-56

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-42B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/OD2SB	CT/5B	VTUN
□	30	.40	.05	.095	248
▽	30	.40	.05	.076	248

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

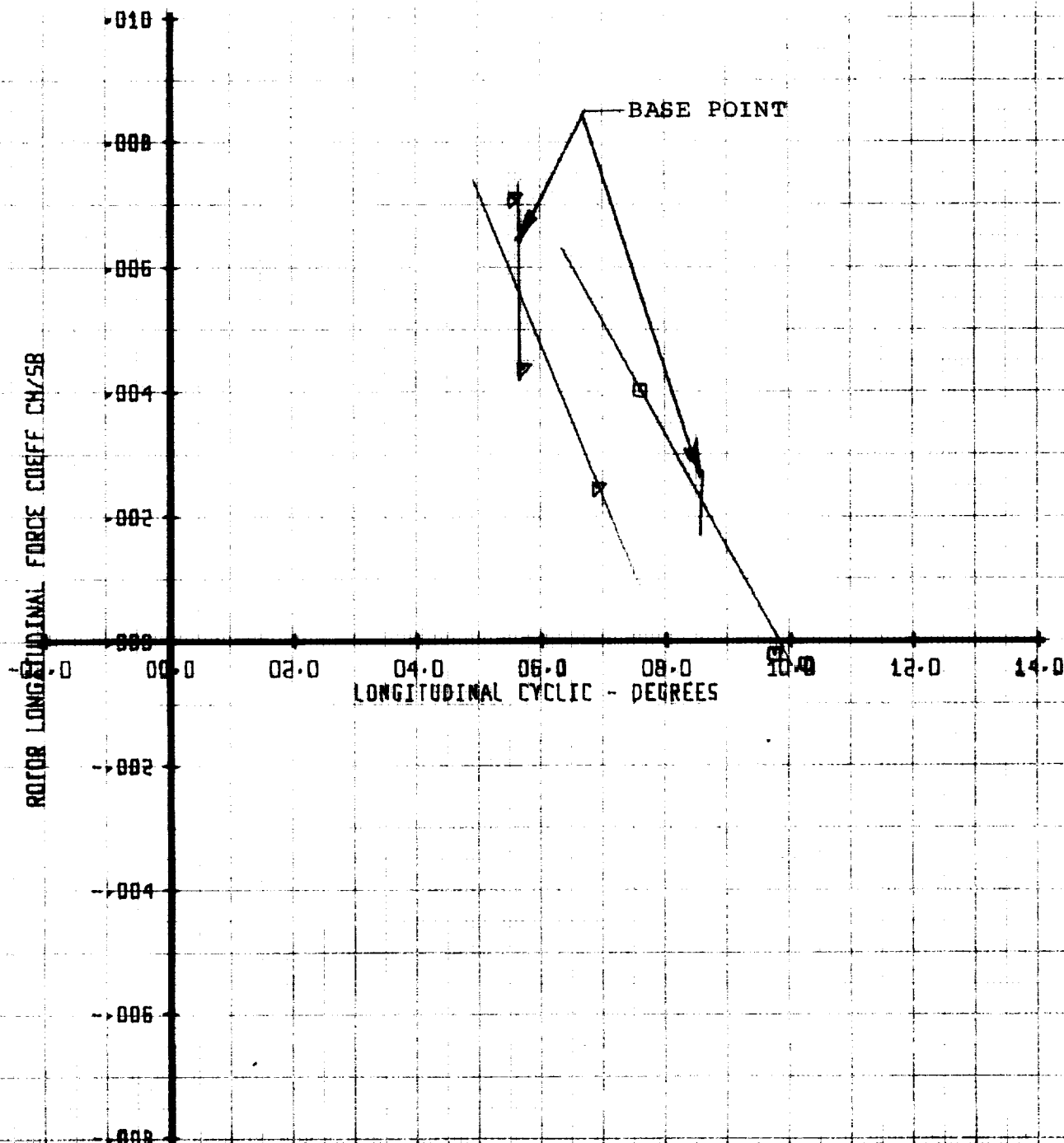


Figure C-57

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML	X/00258	CL/58	VTUN
□	30	.40	.05	.095	248
▽	30	.40	.05	.076	249

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

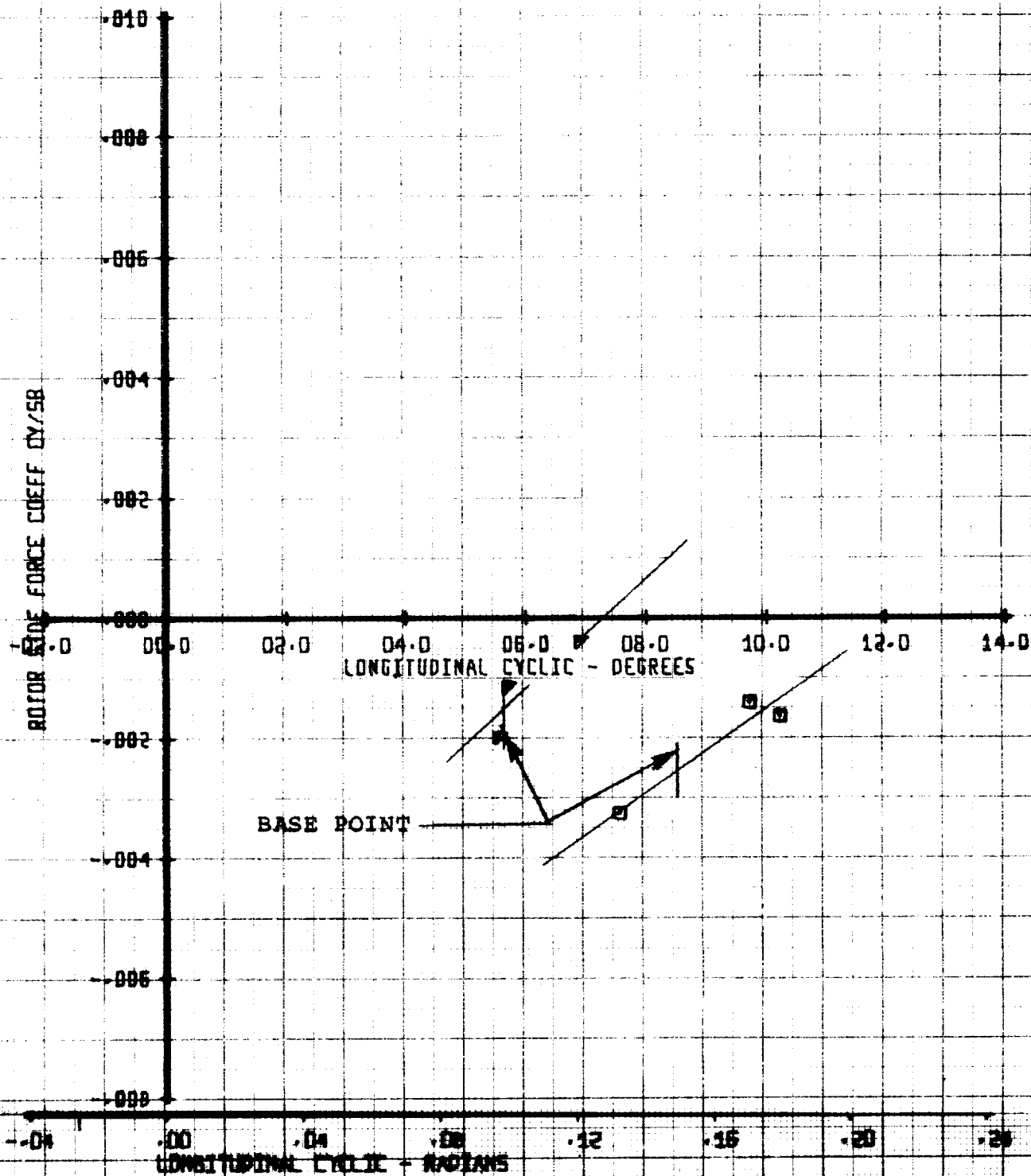


Figure C-58

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	ML	X/00258	CT/98	VTUN
□	30	.40	.05	.095	248
●	30	.40	.05	.076	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC

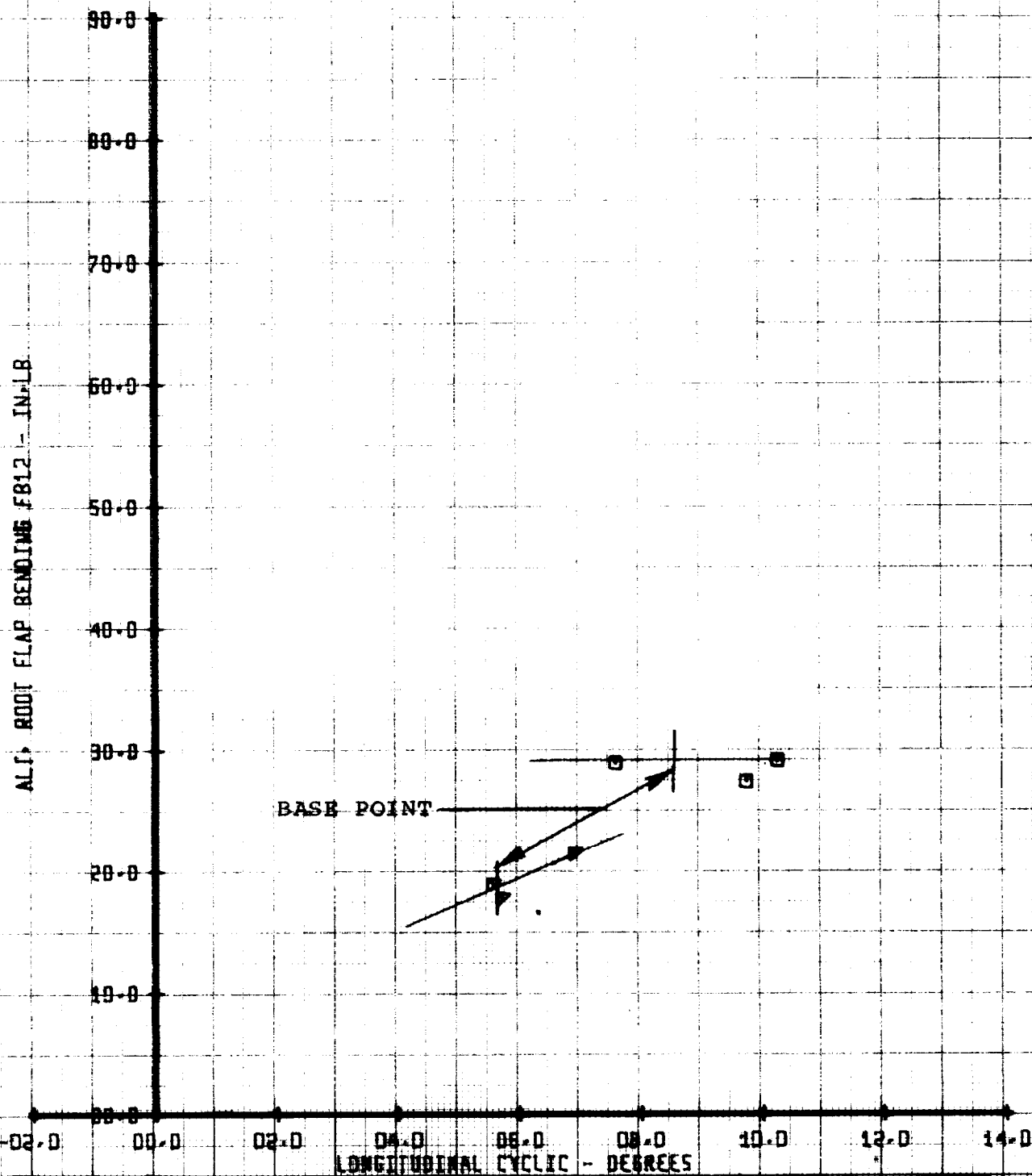


Figure C-59

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
0	30	.40	.05	.095	248
0	30	.40	.05	.076	248

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LONGITUDINAL CYCLIC

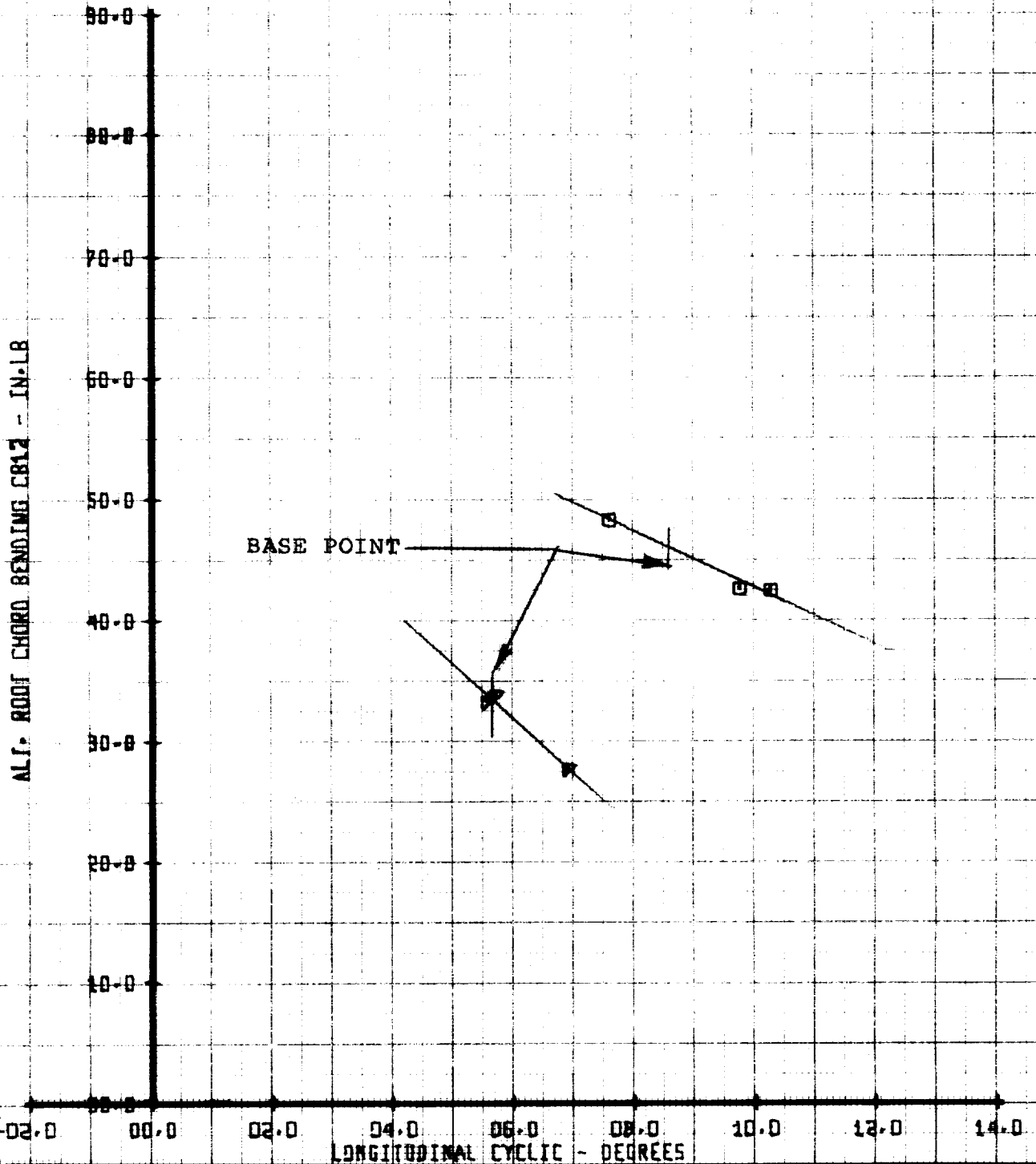


Figure C-60

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SIM	RUN	ML'	X/0025B	CT'/5B	VTUN
0	30	.40	.05	.095	248
7	30	.40	.05	.076	248

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC

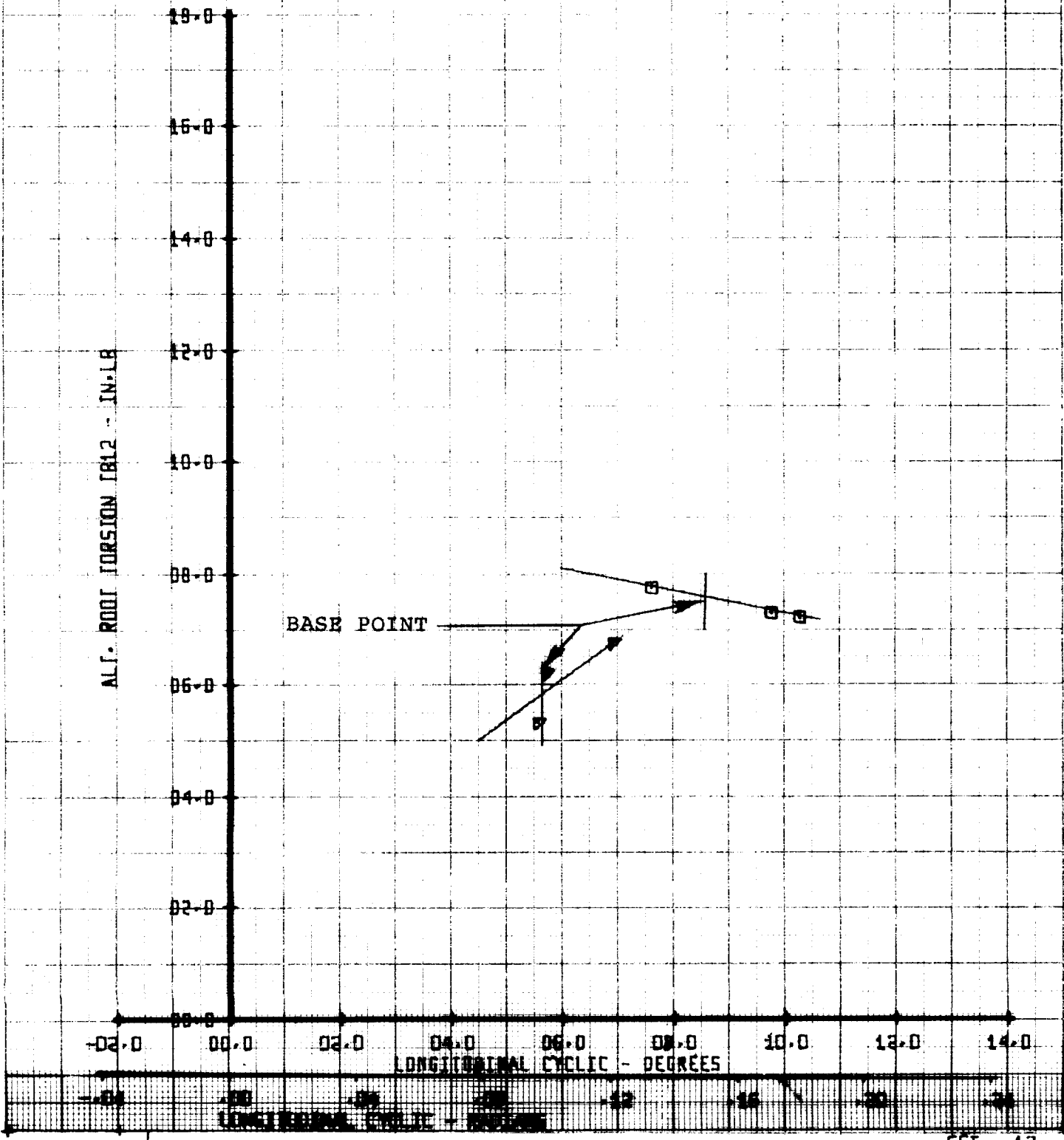


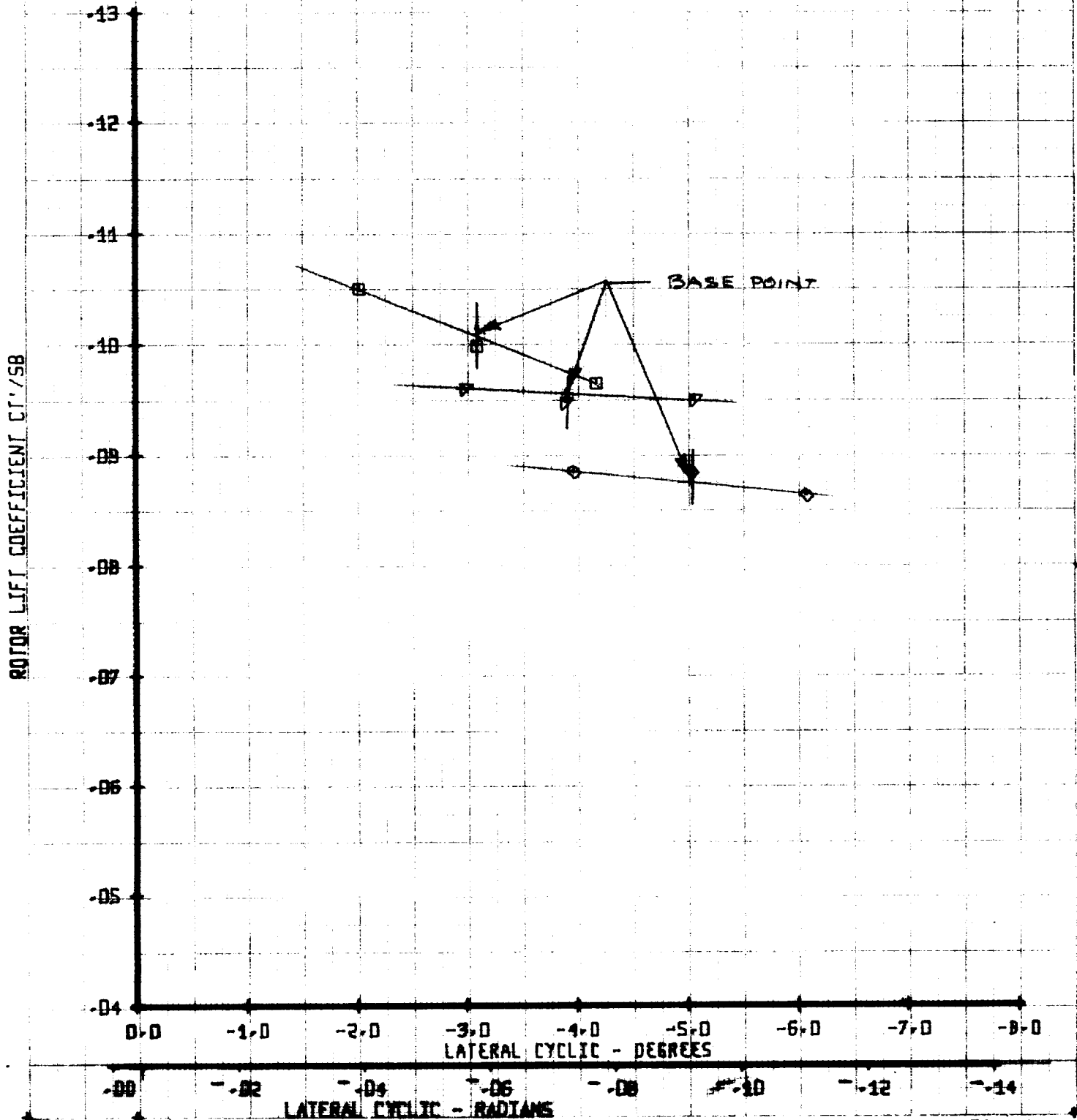
Figure C-61

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC



SET 14
BVWT 187

Figure C-62

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

S/N	RUN	MU'	X/002SB	CT'/SB	VTUN
0	32	.40	.01	.100	248
7	30	.40	.05	.095	248
0	33	.40	.10	.088	248

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

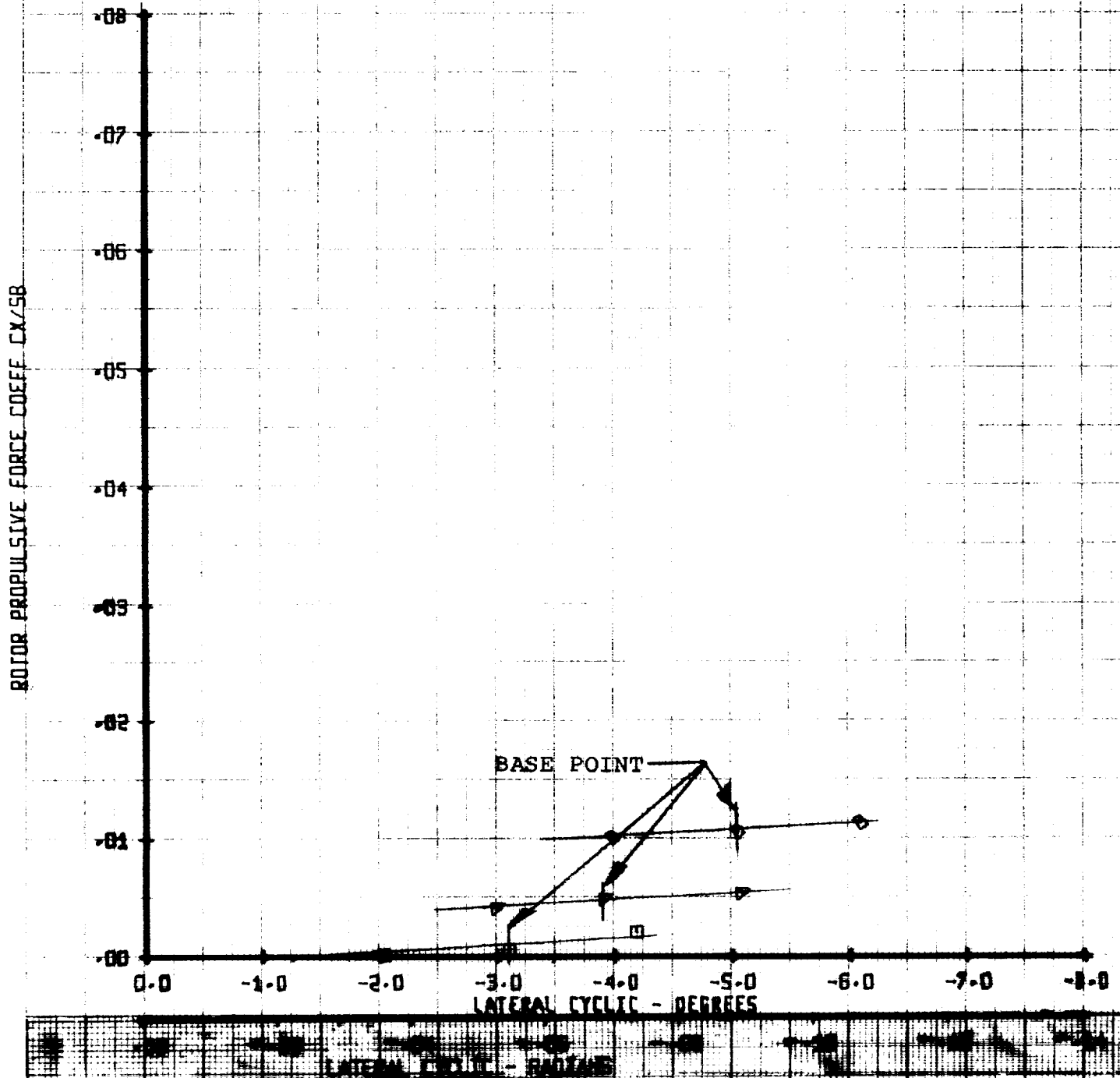


Figure C-63

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML	X/00258	CT'/58	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.085	248
◇	33	.40	.10	.088	248

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

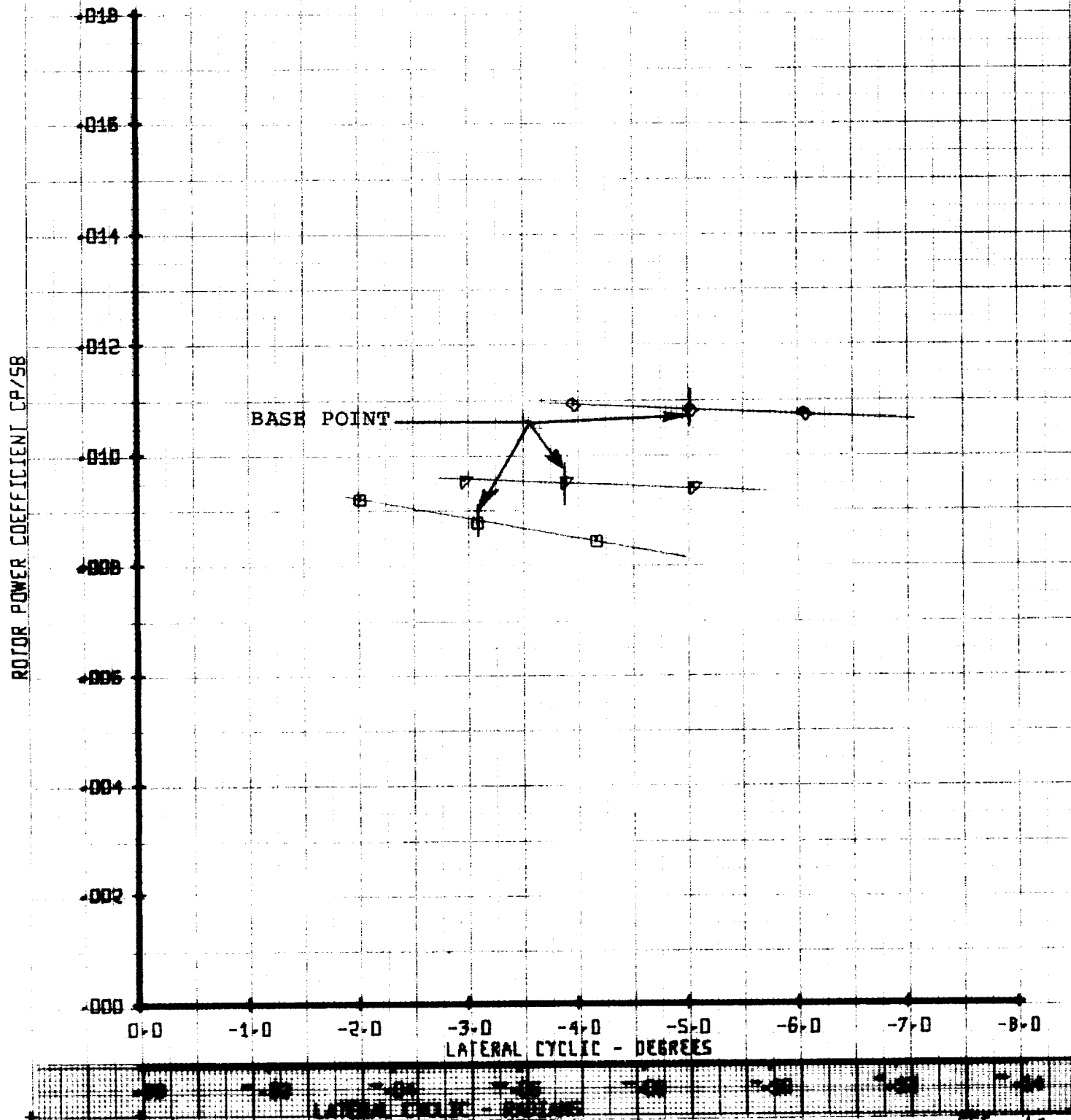


Figure C-64

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-42B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ROTOR PITCHING MOMENT COEFFICIENT

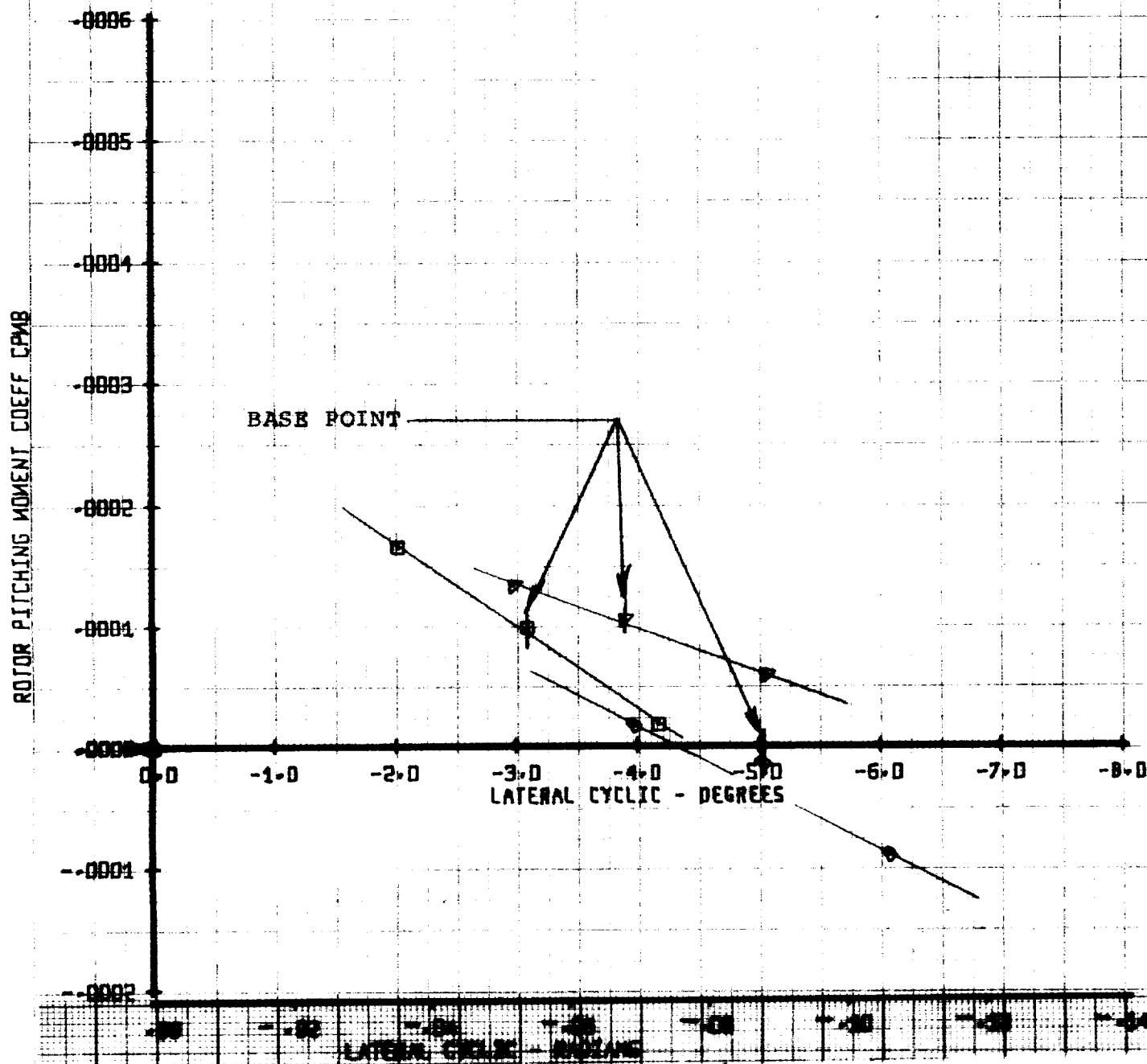
VERSUS
LATERAL CYCLIC

Figure C-65

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/CD2SB	CT/SB	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

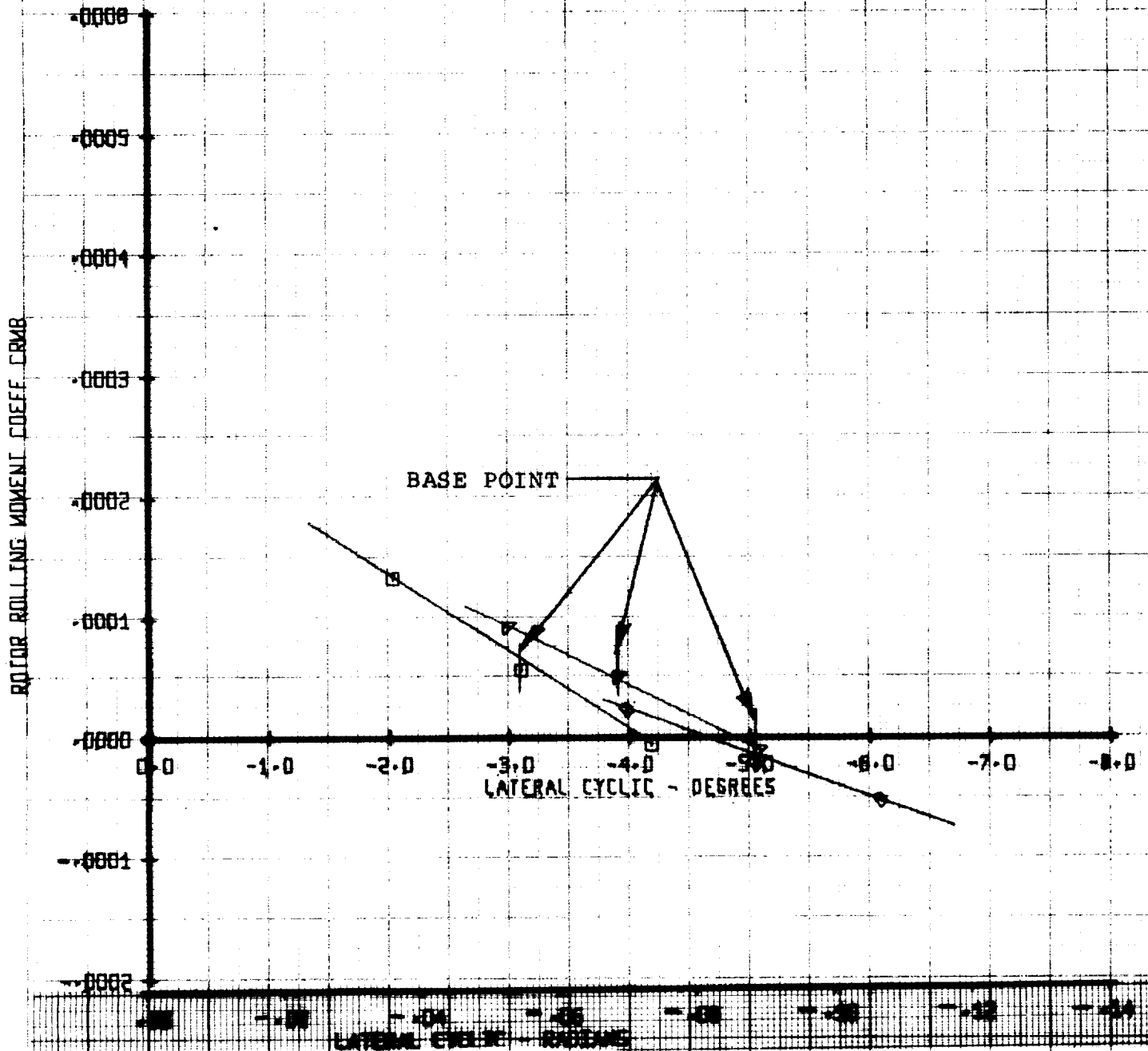


Figure C-66

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD2SB	CT'/SB	VTUN
□	32	.40	.01	.100	248
▽	30	.40	.05	.095	248
◆	33	.40	.10	.088	248

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

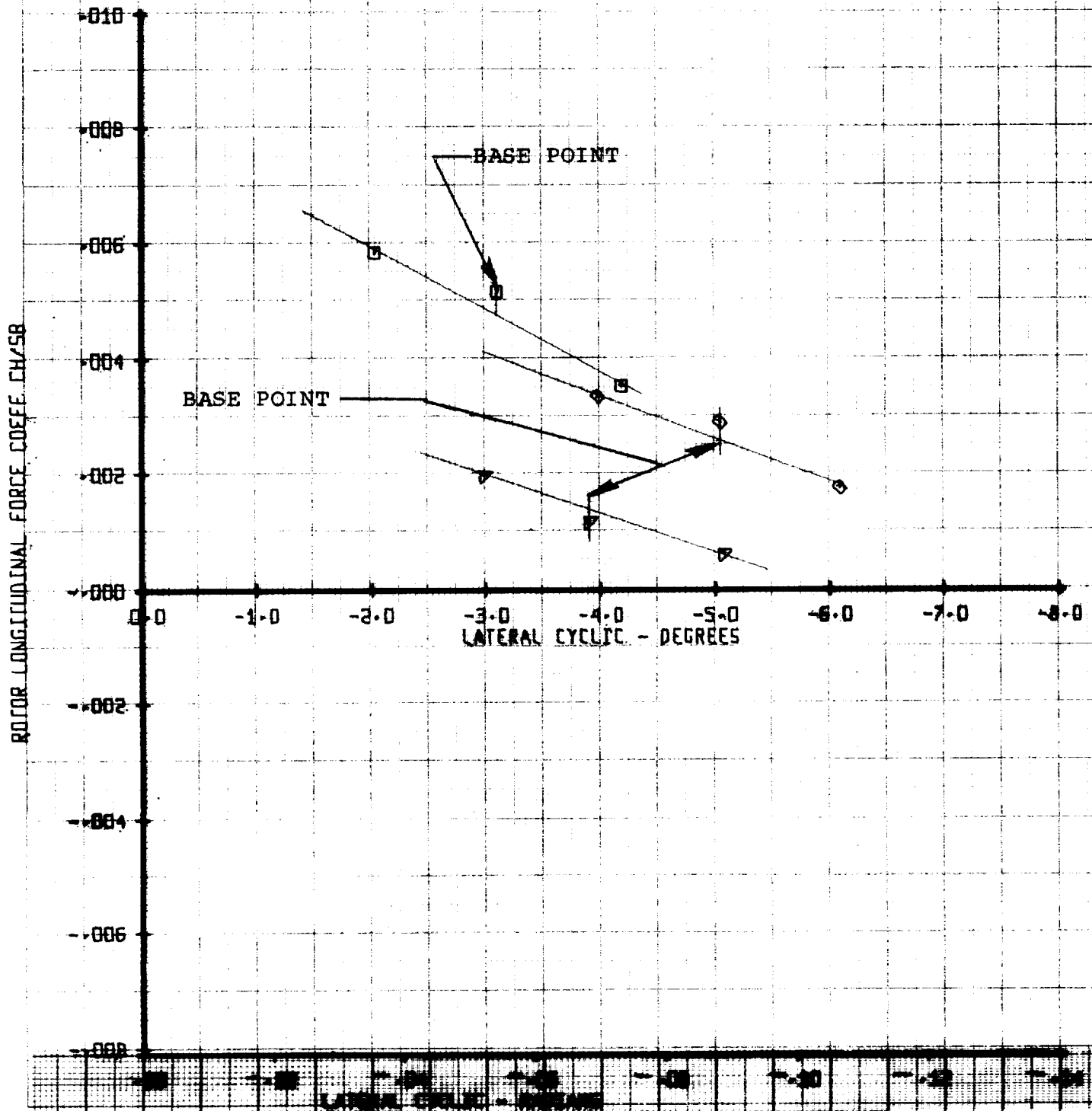


Figure C-67

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

S/N	RUN	MU'	X/CD2SB	CT'/SB	VTUN
32	32	.40	.01	.100	248
30	30	.40	.05	.095	248
33	33	.40	.18	.088	248

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

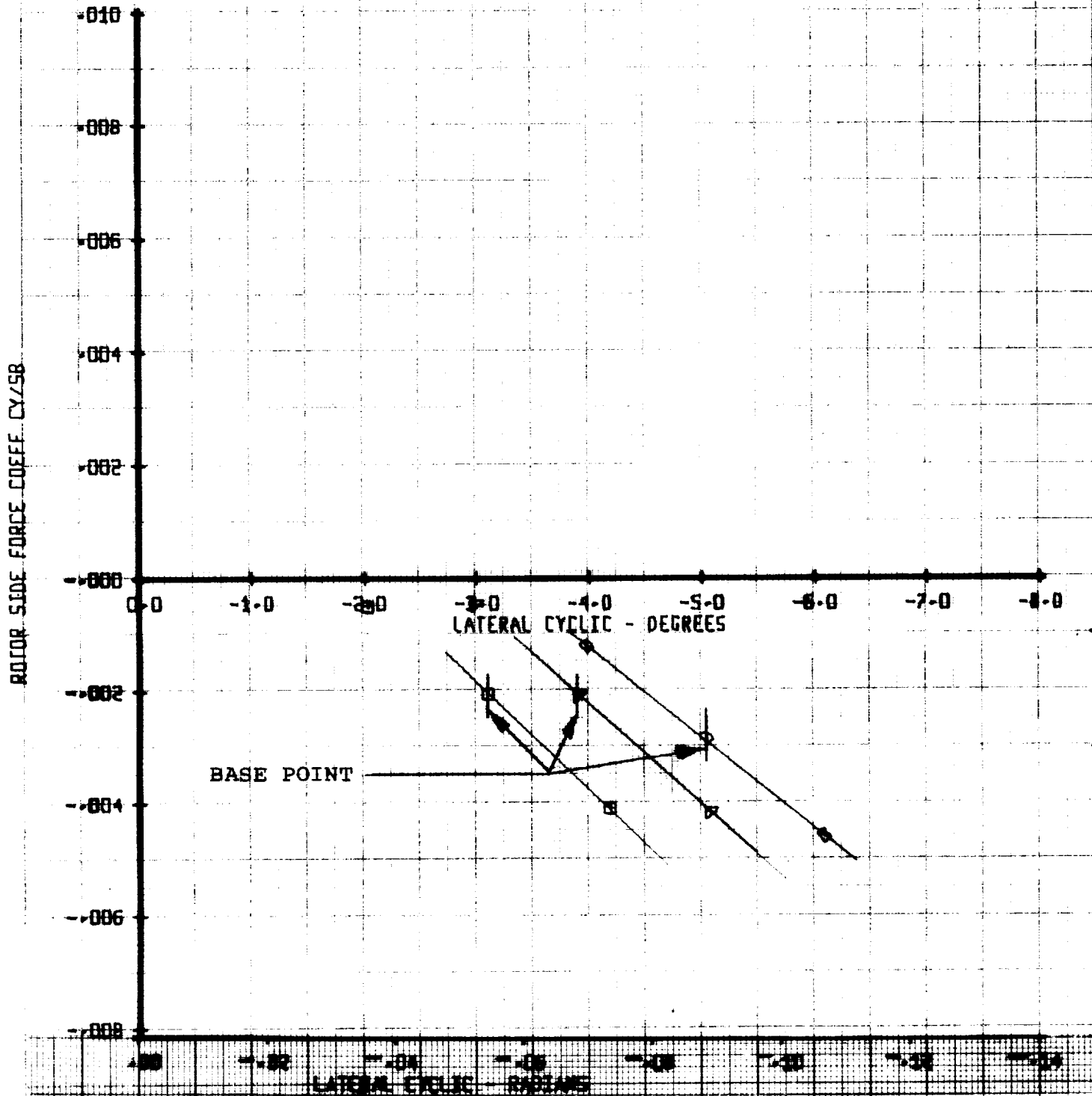


Figure C-68

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	YTUN
□	32	.40	.01	.100	248
◇	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

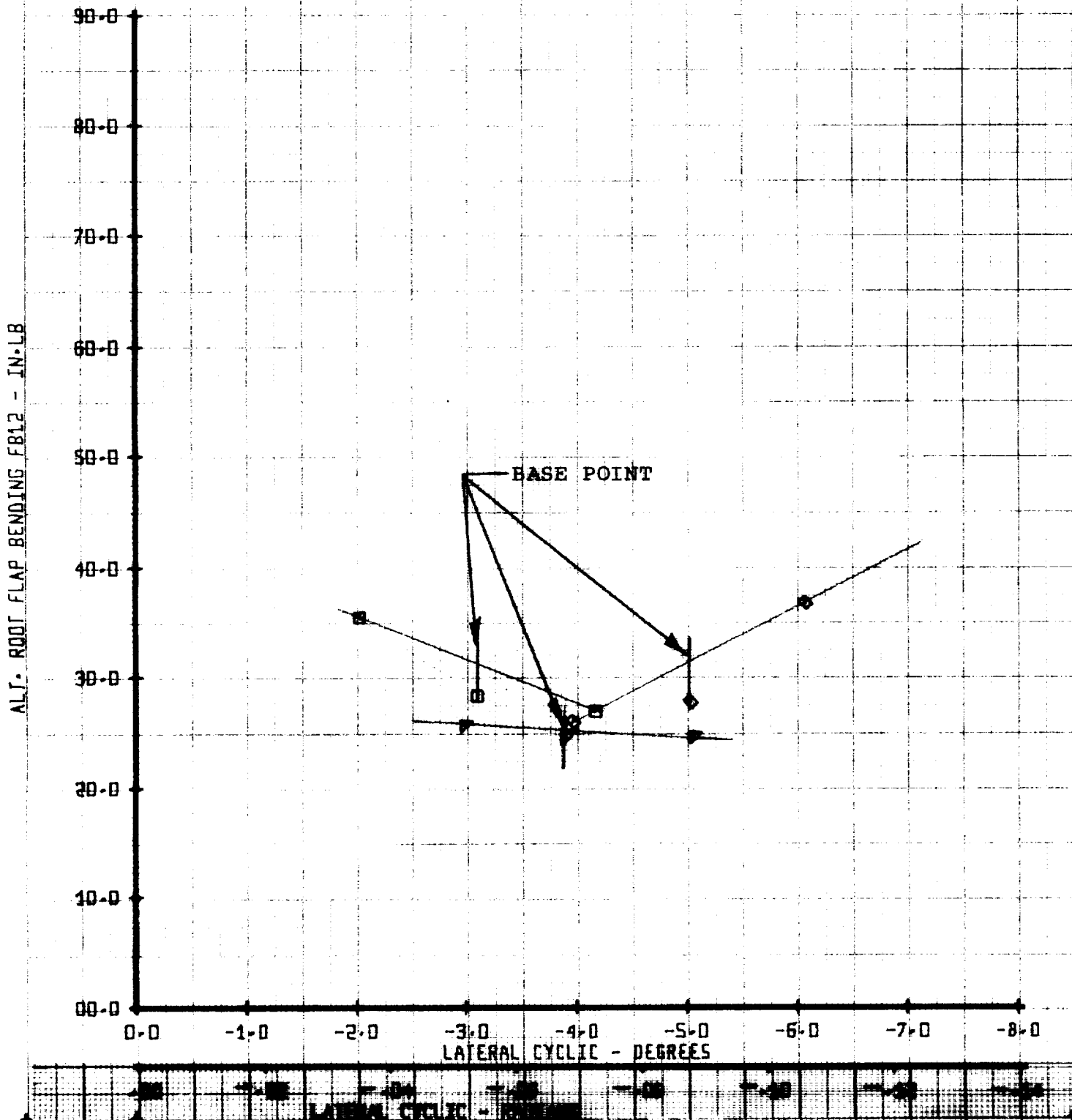


Figure C-69

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	32	.40	.01	.100	248
▽	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LATERAL CYCLIC

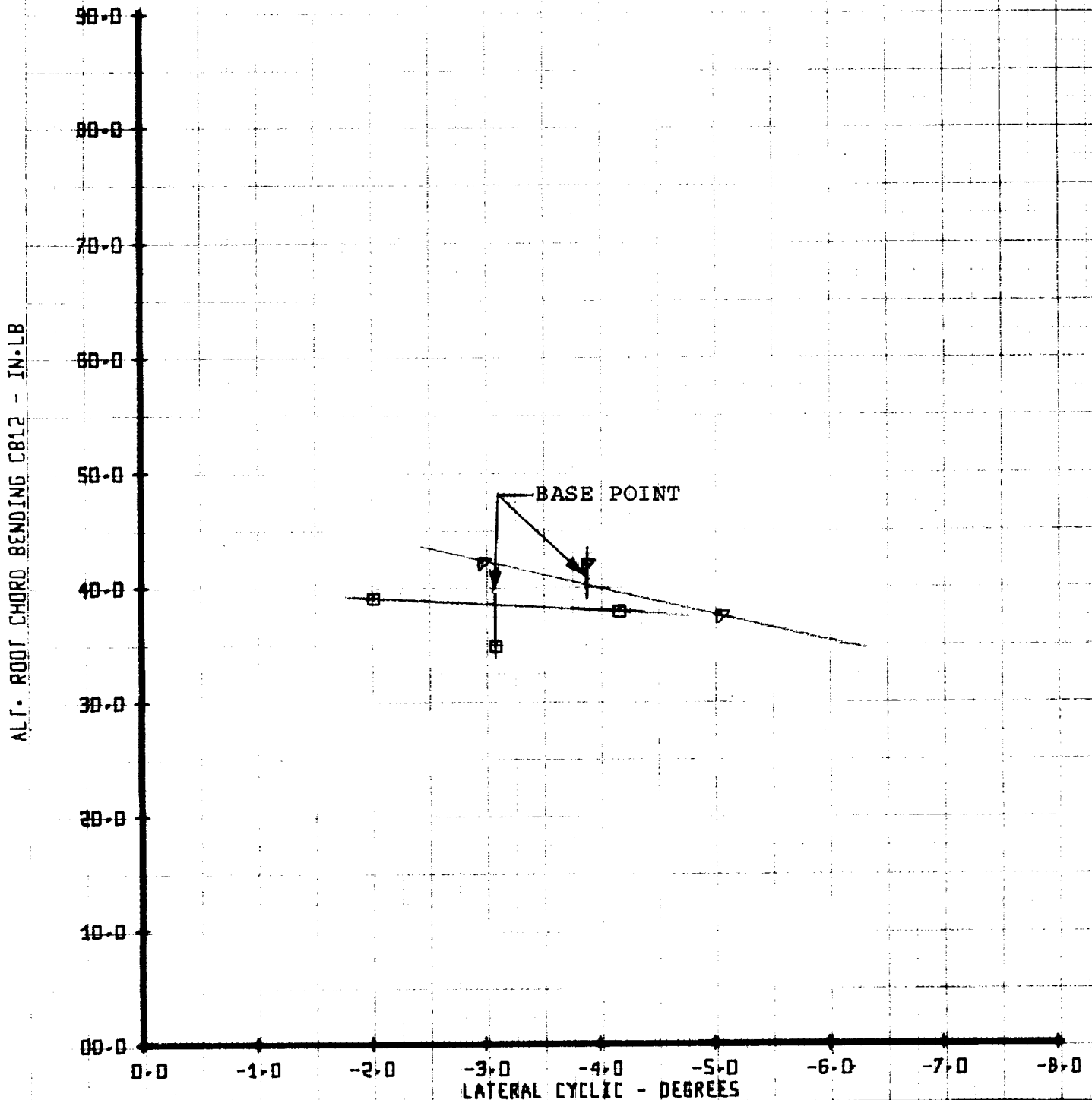


Figure C-70

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT/5B	YTUN
□	32	.40	.01	.100	248
▽	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ALTERNATING ROOT TORSION TB12
 VERSUS
 LATERAL CYCLIC

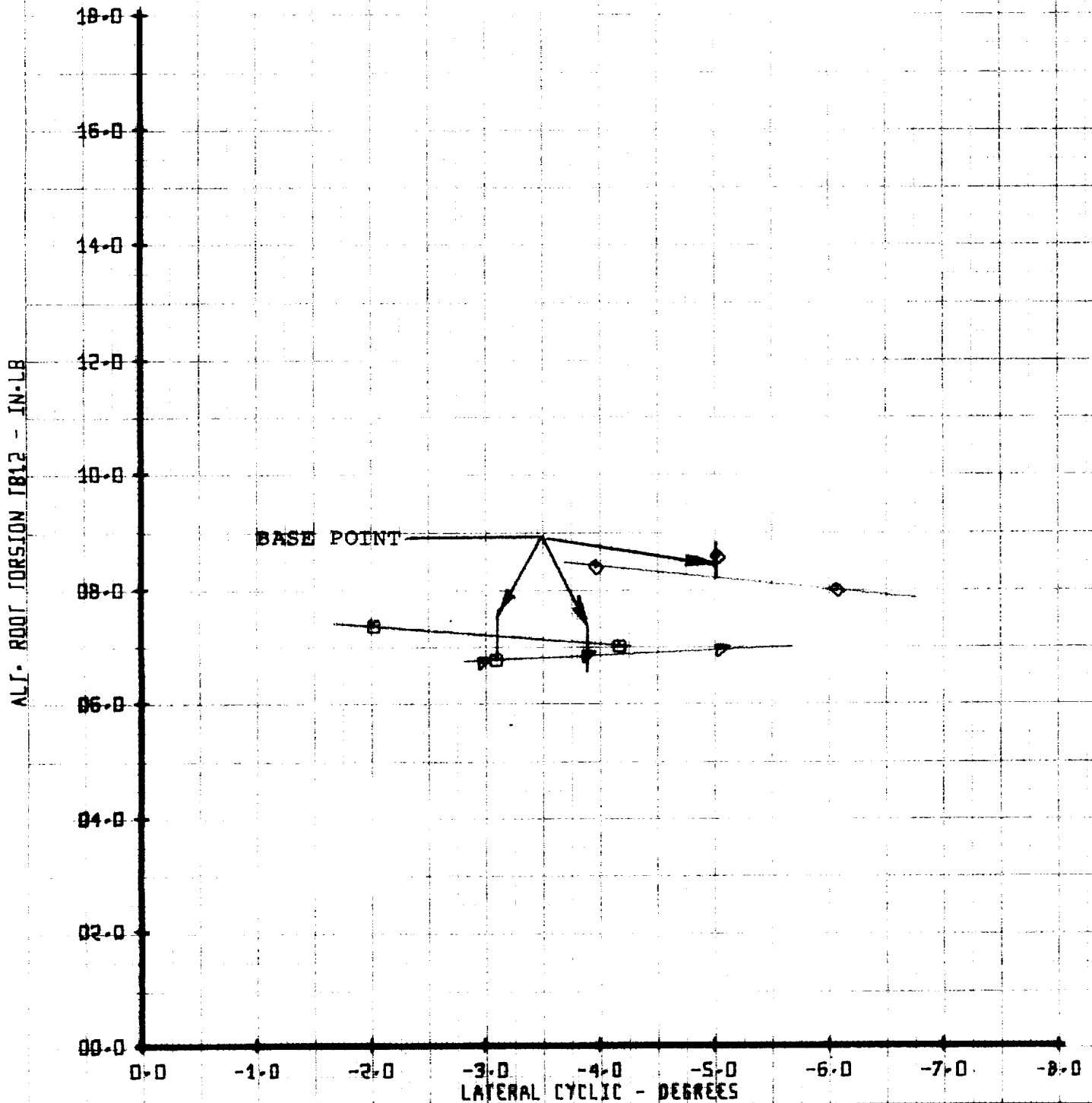


Figure C-71

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
□	32	.40	.01	.077	248
▽	30	.40	.05	.076	248
◇	33	.40	.10	.070	248

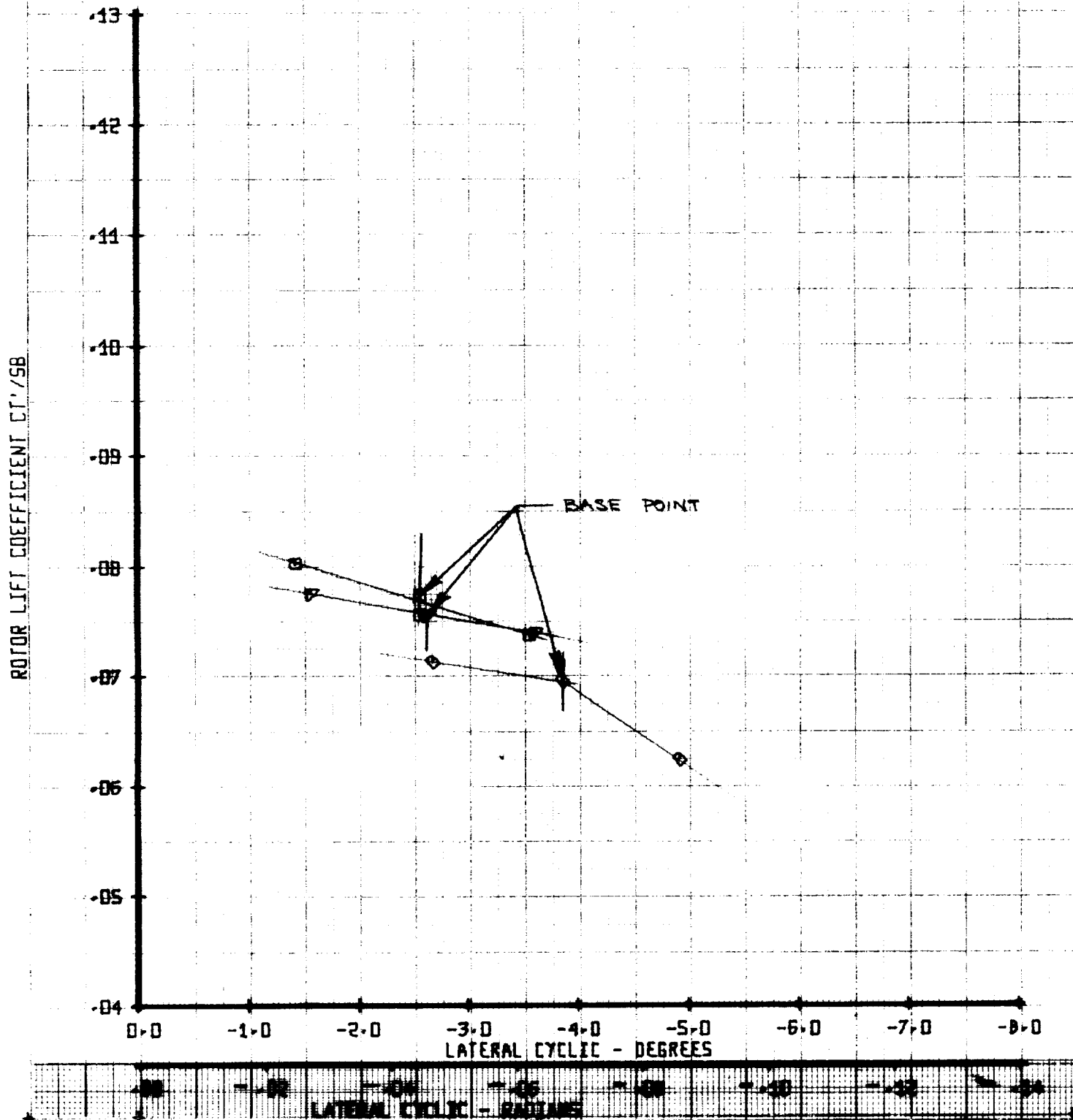
 ROTOR LIFT COEFFICIENT
 VERSUS
 LATERAL CYCLIC


Figure C-72

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD258	CT'/SB	VTUN
□	32	.40	.01	.077	248
△	30	.40	.05	.076	248
◇	33	.40	.10	.070	248

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

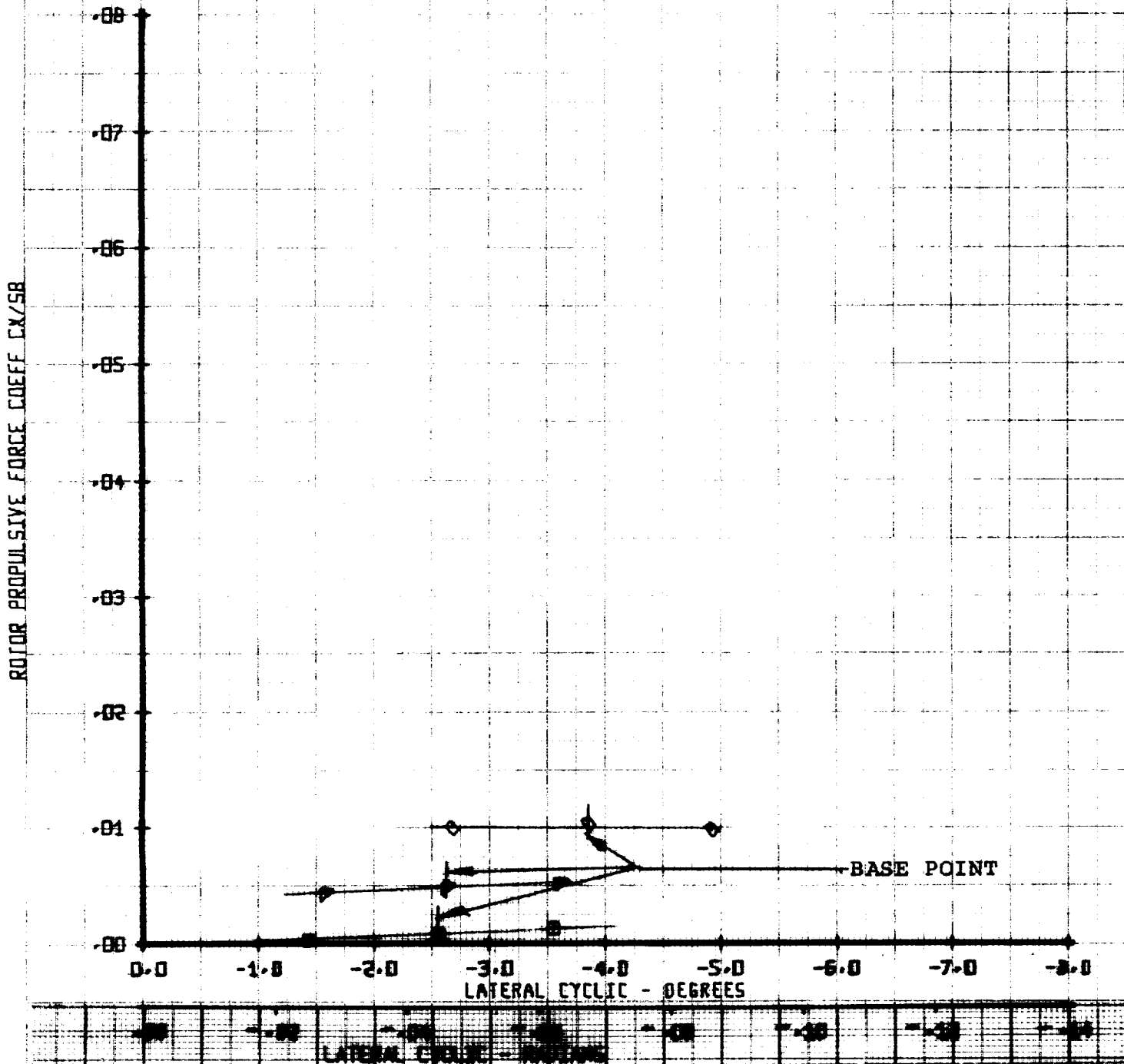


Figure C-73

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/D0258	CT'/SB	VTUN
□	32	.40	.01	.077	248
△	30	.40	.05	.076	248
◇	33	.40	.10	.070	248

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

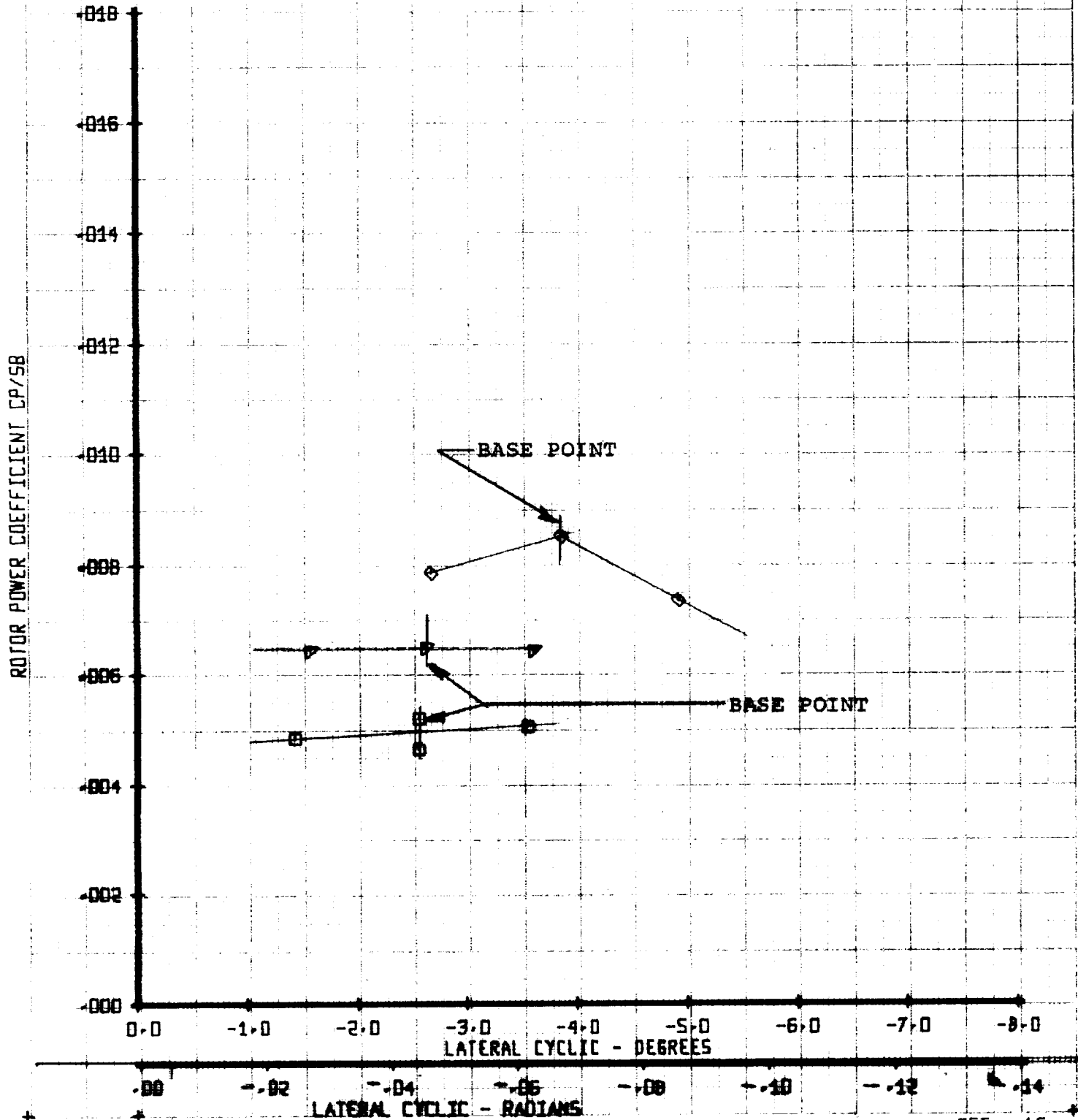


Figure C-74

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/OD2SB	CT'/SB	VTUN
□	32	.40	.01	.077	248
△	30	.40	.05	.076	248
◇	33	.40	.10	.070	248

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

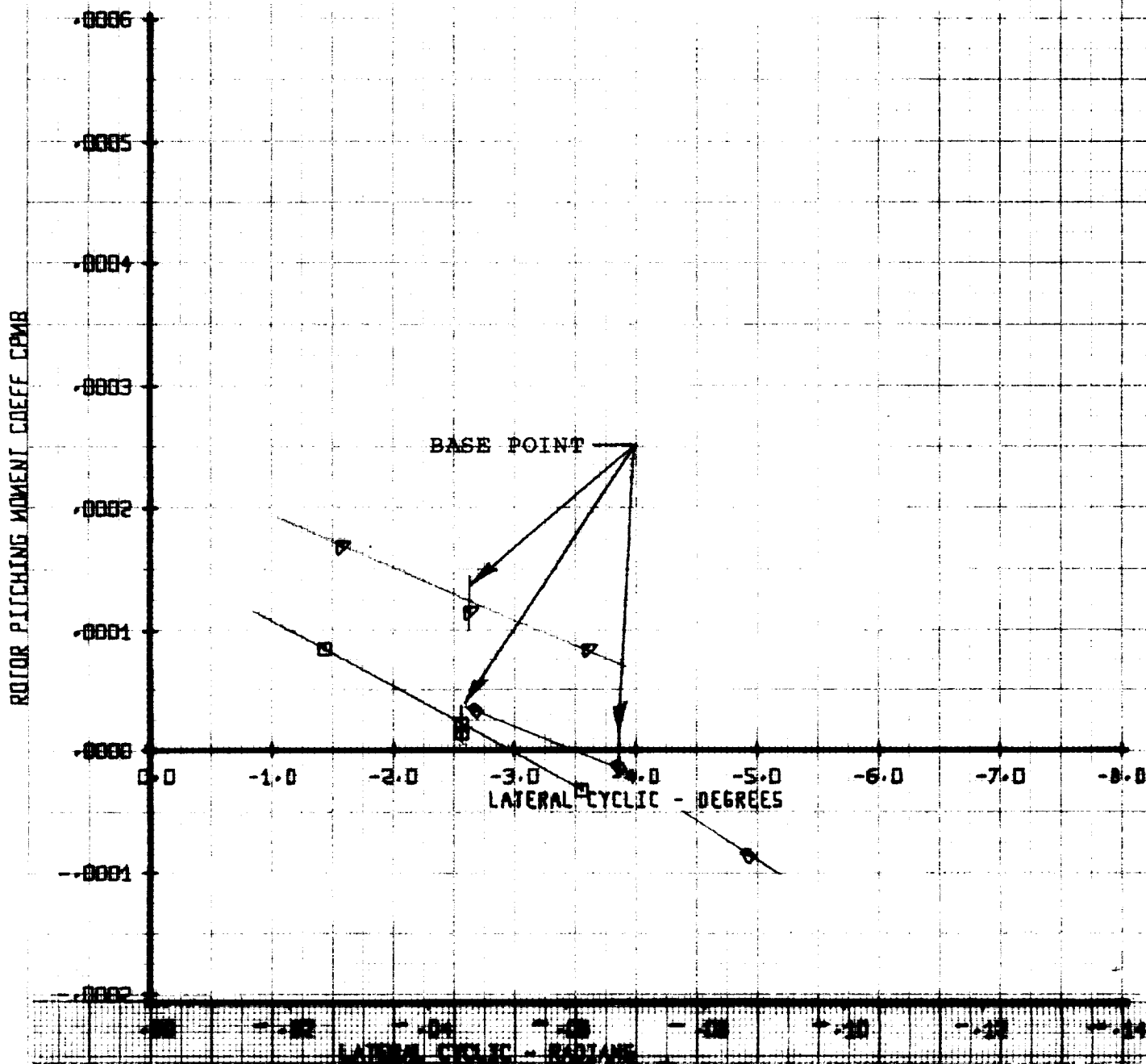


Figure C-75

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD258	CT'/SB	VTUN
□	32	.40	.01	.077	248
△	30	.40	.05	.076	248
◇	33	.48	.10	.078	248

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

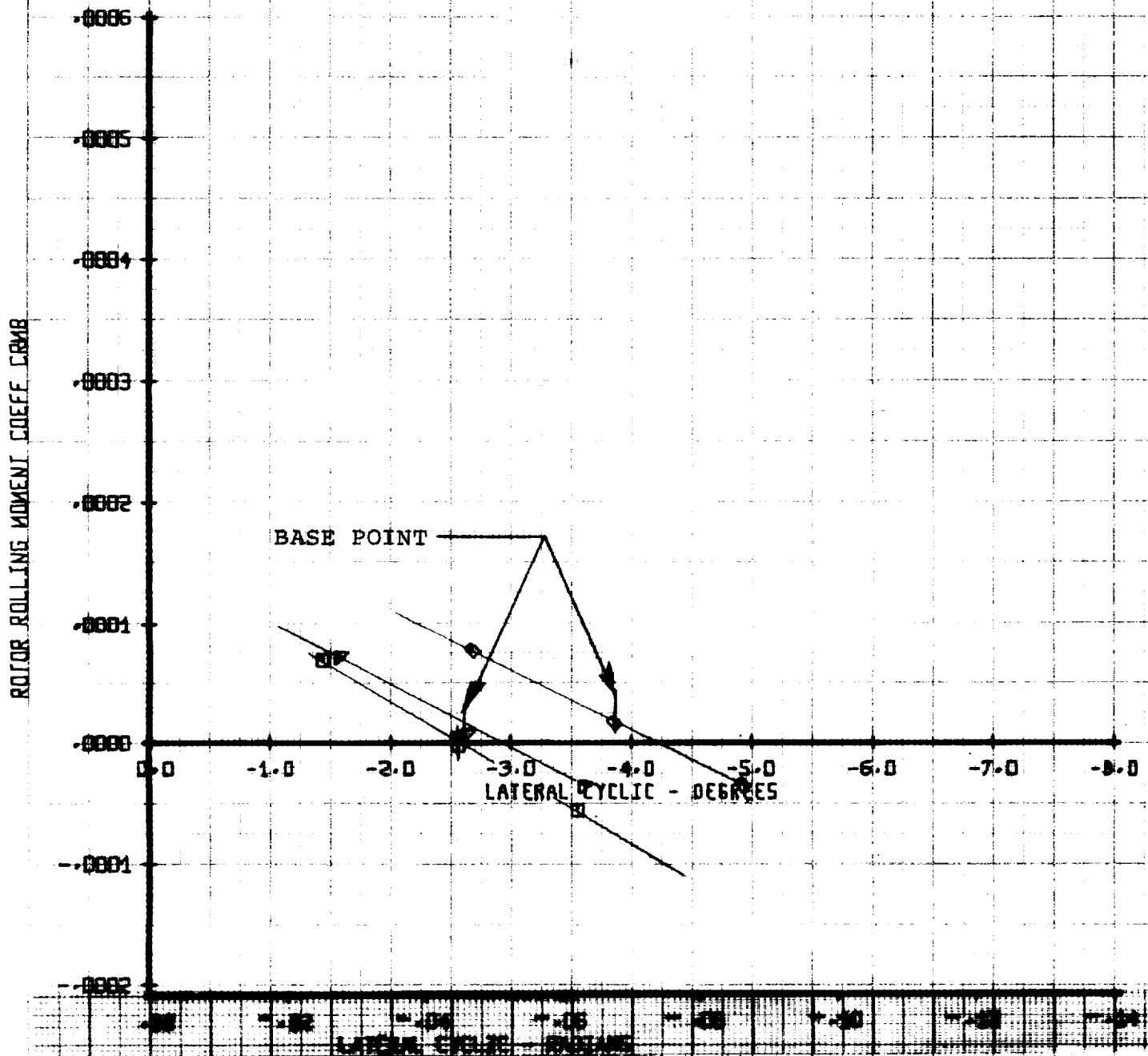


Figure C-76

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD258	CT'/SB	VTUN
□	32	.40	.01	.077	248
△	30	.40	.05	.076	248
◇	33	.40	.10	.078	248

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

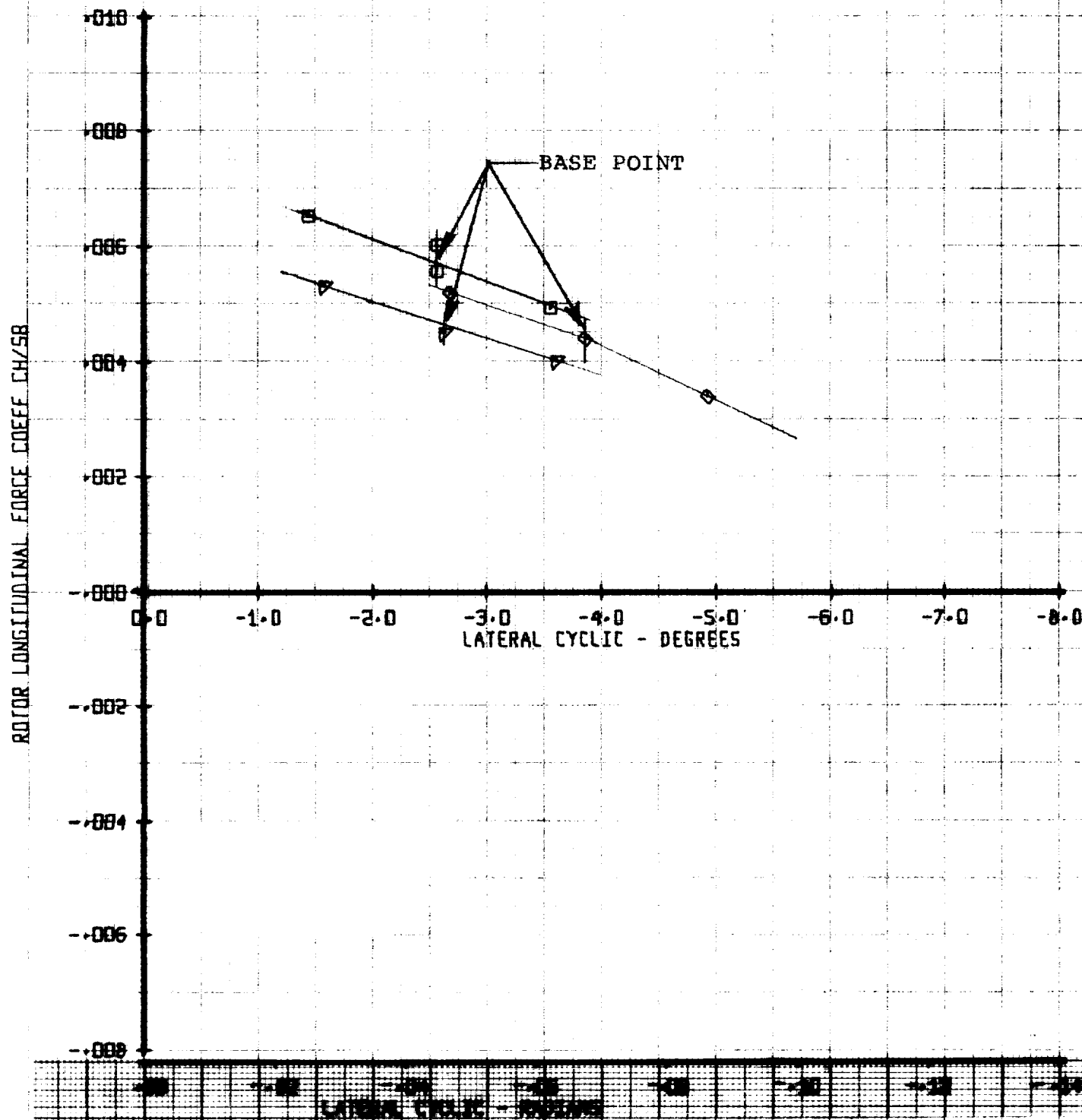


Figure C-77

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE OH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	32	.40	.01	.077	248
▽	30	.40	.05	.076	248
◇	33	.40	.10	.079	248

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

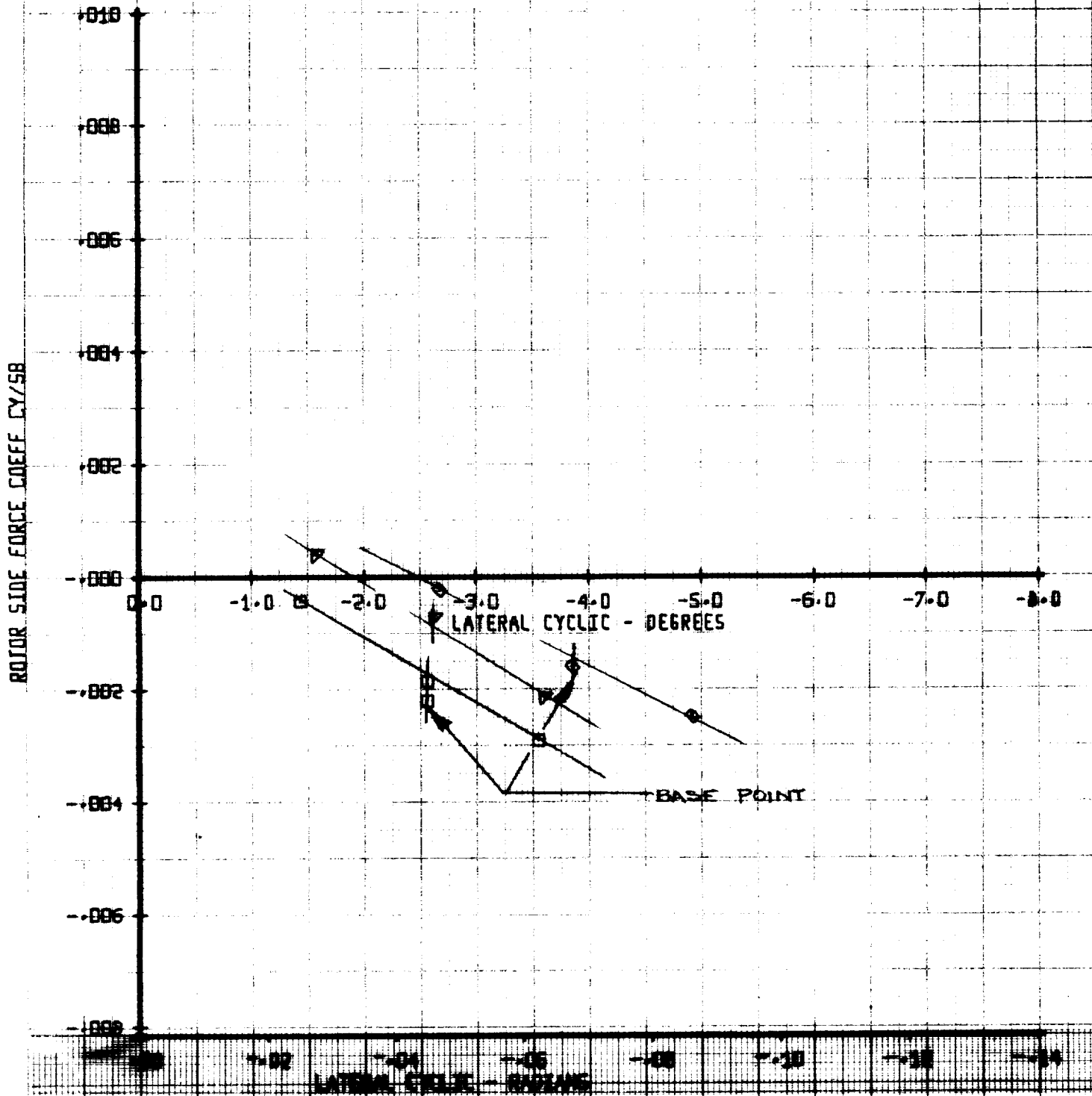


Figure C-78

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD25B	CT'/SB	VTUN
□	32	.40	.01	.077	248
△	30	.40	.05	.076	248
◆	33	.40	.10	.070	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

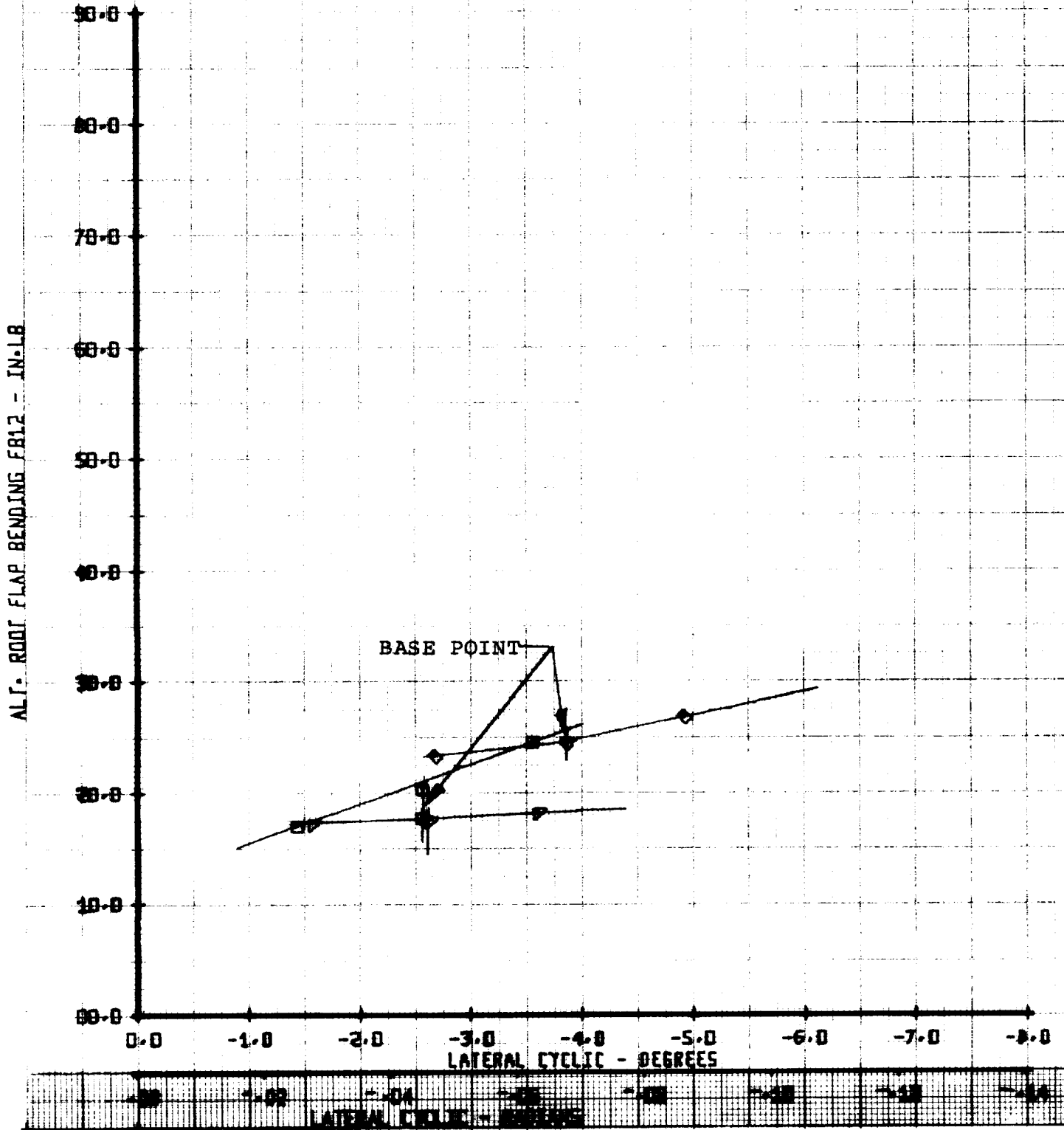


Figure C-79

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/SB	VTUN
□	32	.40	.01	.077	248
△	30	.40	.05	.076	248
◇	33	.40	.10	.078	248

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LATERAL CYCLIC

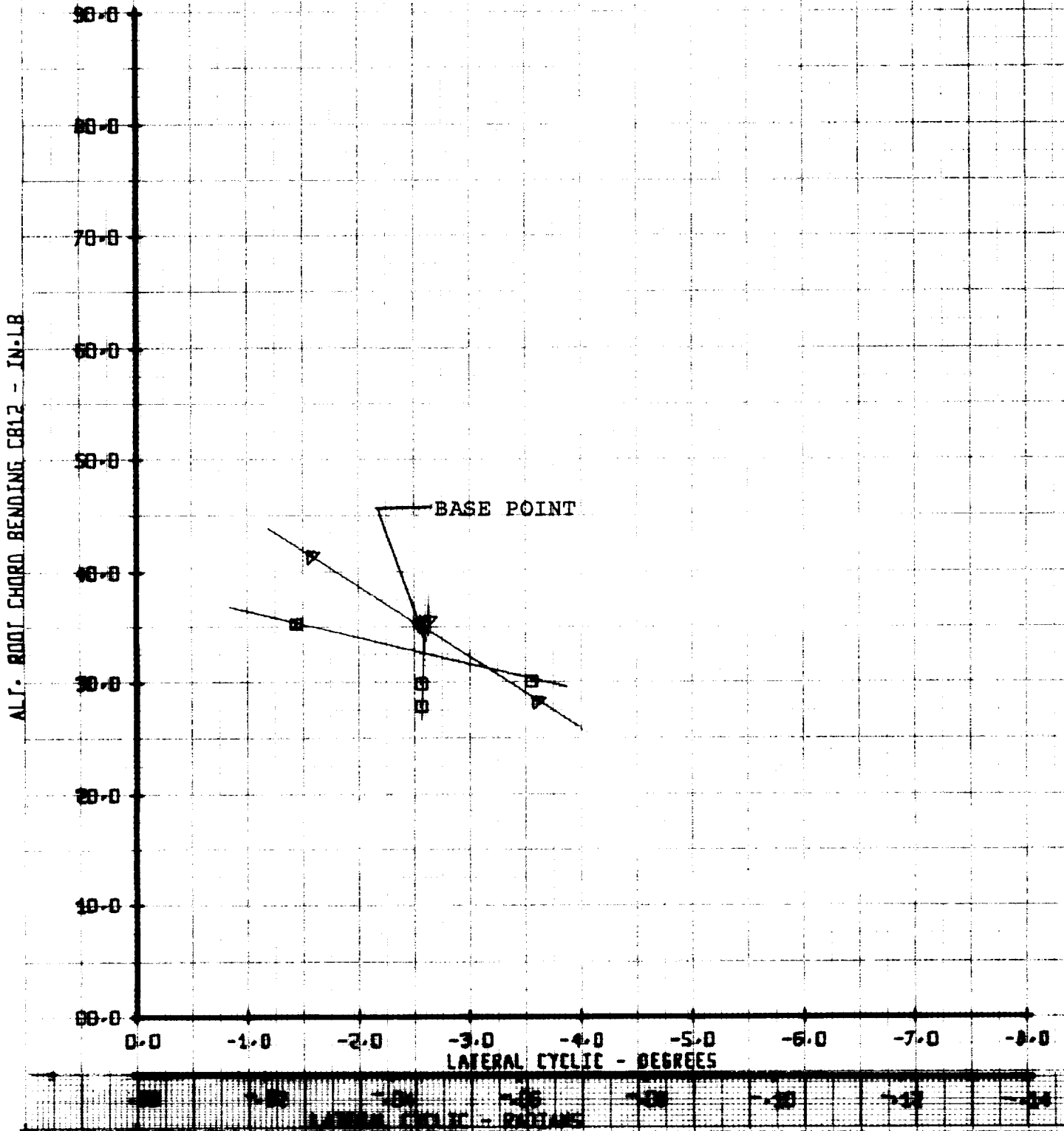


Figure C-80

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD258	CT'/SB	VTUN
□	32	.40	.01	.077	248
△	30	.40	.05	.076	248
◇	33	.40	.10	.078	248

ALTERNATING ROOT TORSION TB12
VERSUS
LATERAL CYCLIC

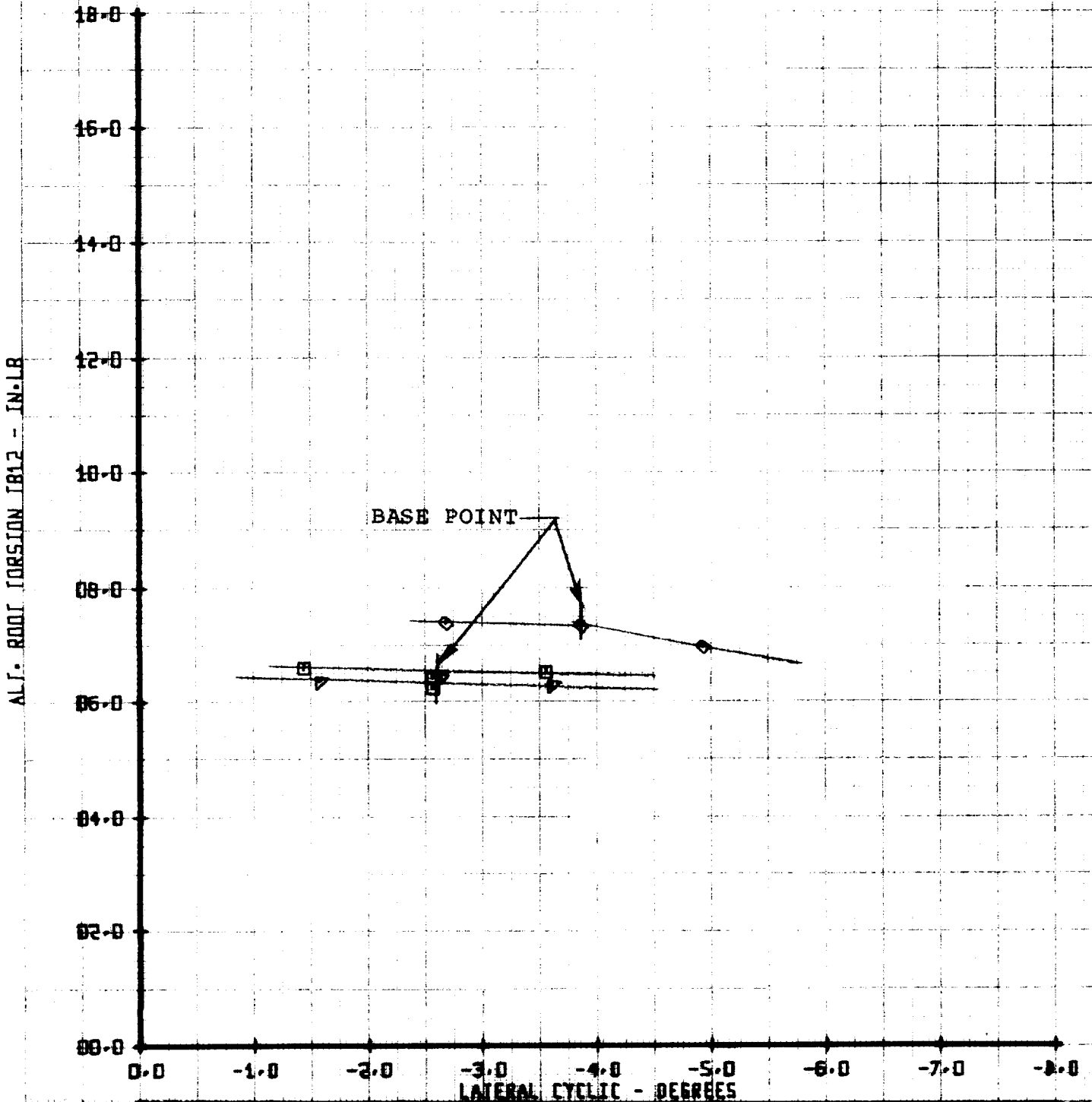


Figure C-81

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
□	32	.40	.01	.100	248
△	32	.40	.01	.077	248

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC

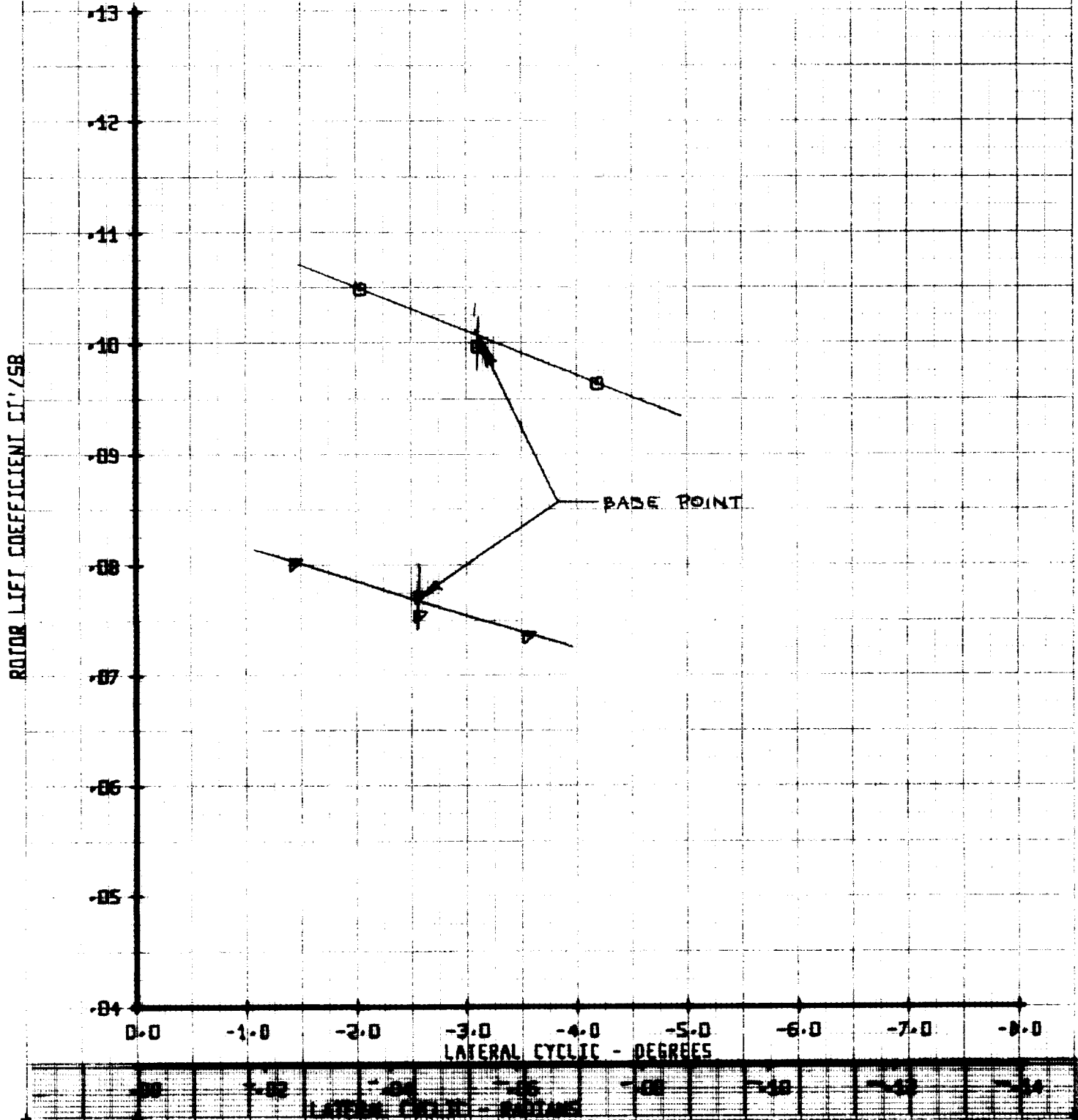


Figure C-82

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD2SB	CT'/SB	VTUN
□	32	.40	.01	.100	248
▽	32	.40	.01	.077	248

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

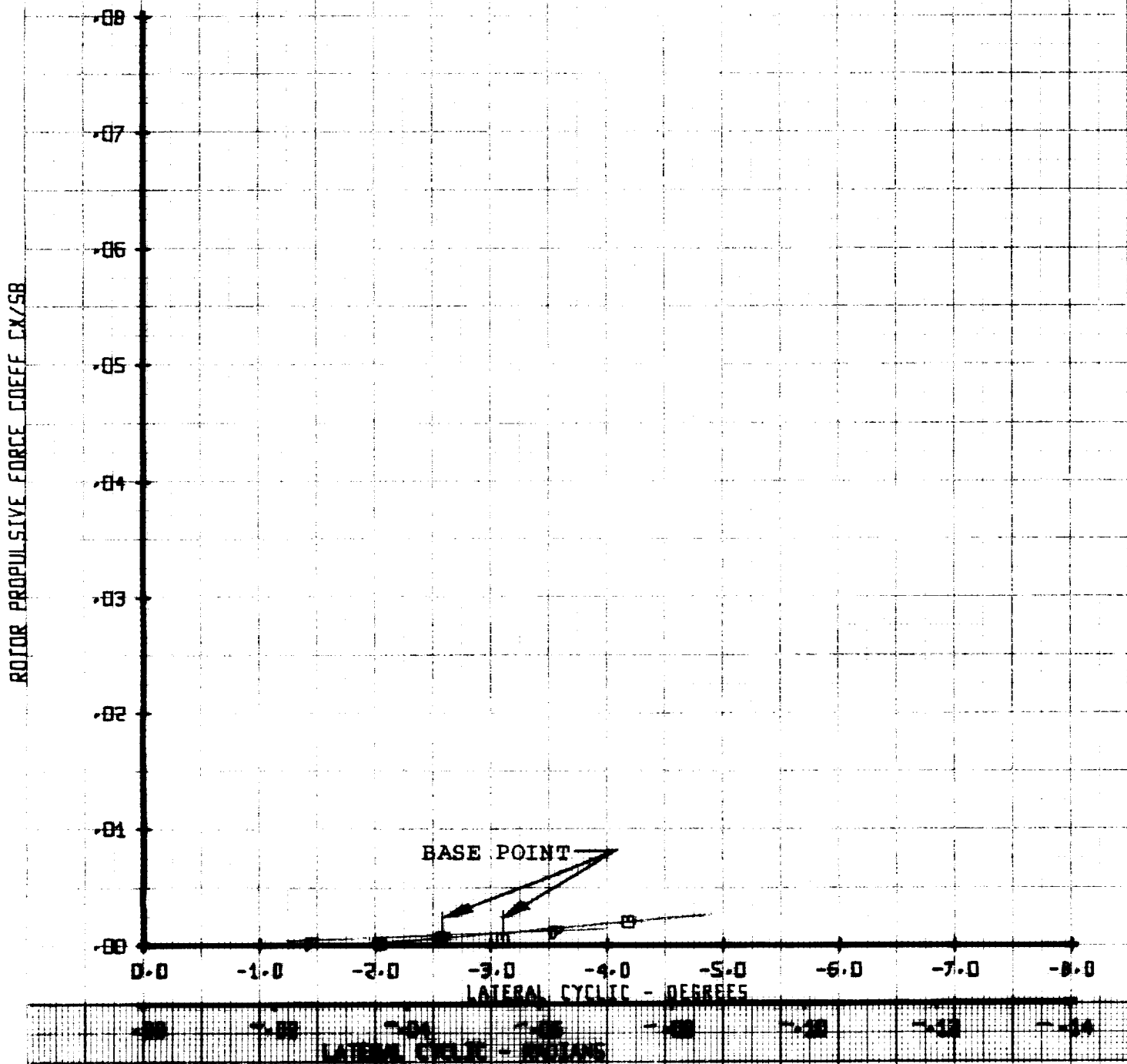


Figure C-83

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	MAN	MU	X/00258	CT'/SB	VTUN
□	32	.40	.01	.100	248
▽	32	.40	.01	.077	248

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

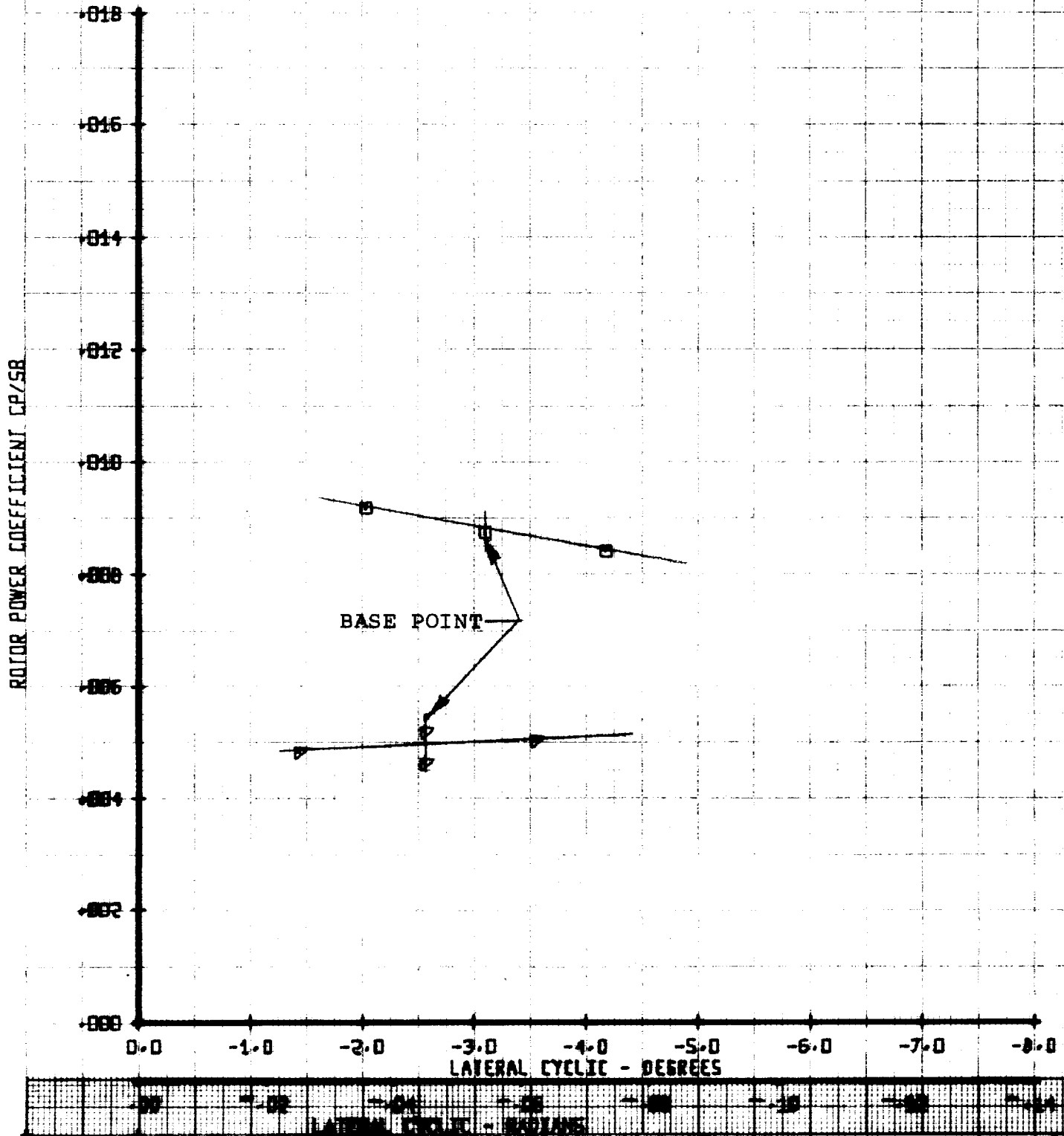


Figure C-84

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
0	32	.40	.01	.100	248
7	32	.40	.01	.077	248

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

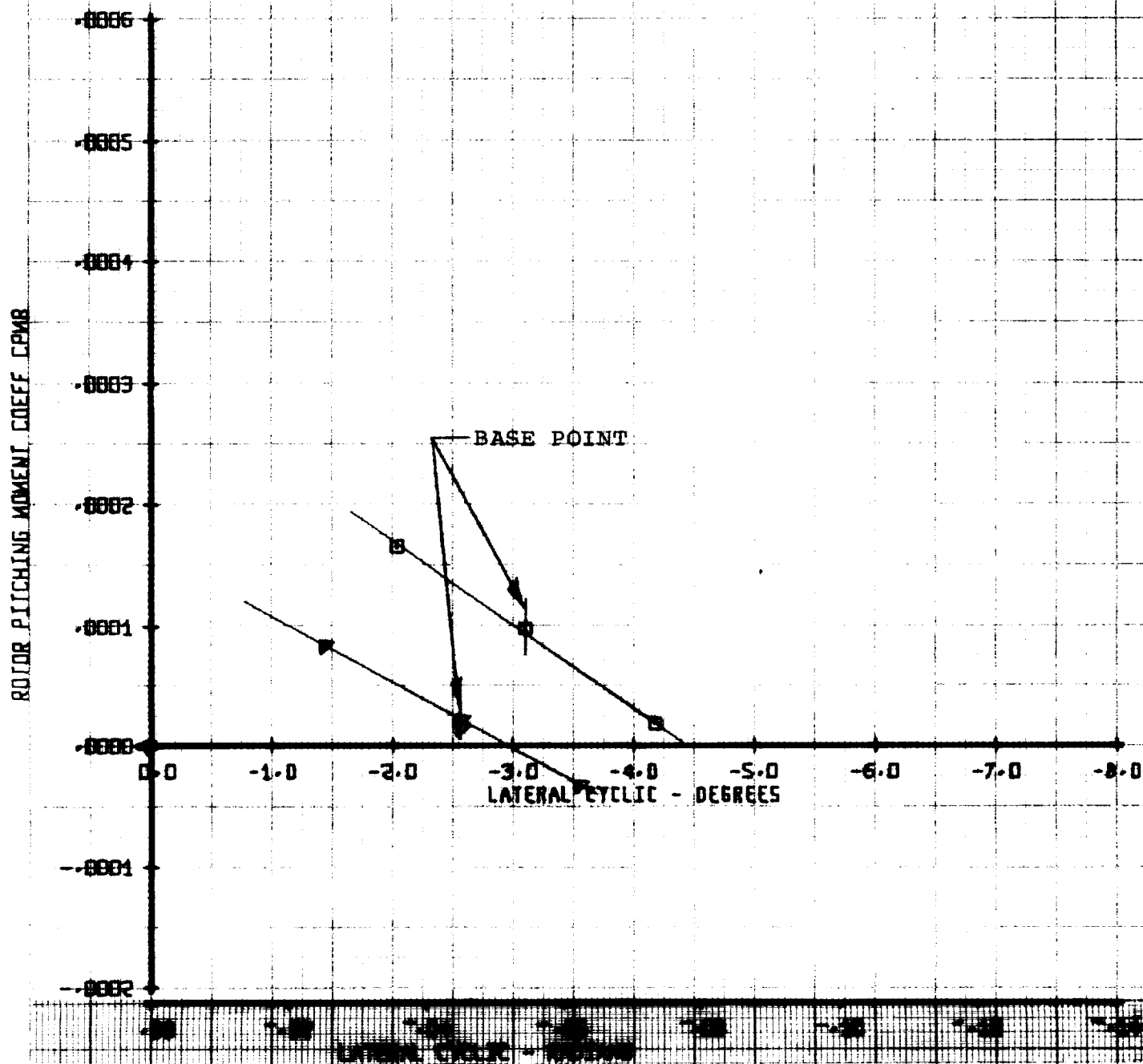


Figure C-85

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE OH-47E ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT1/58	VTUN
0	32	.40	.01	.100	248
7	32	.40	.01	.077	248

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

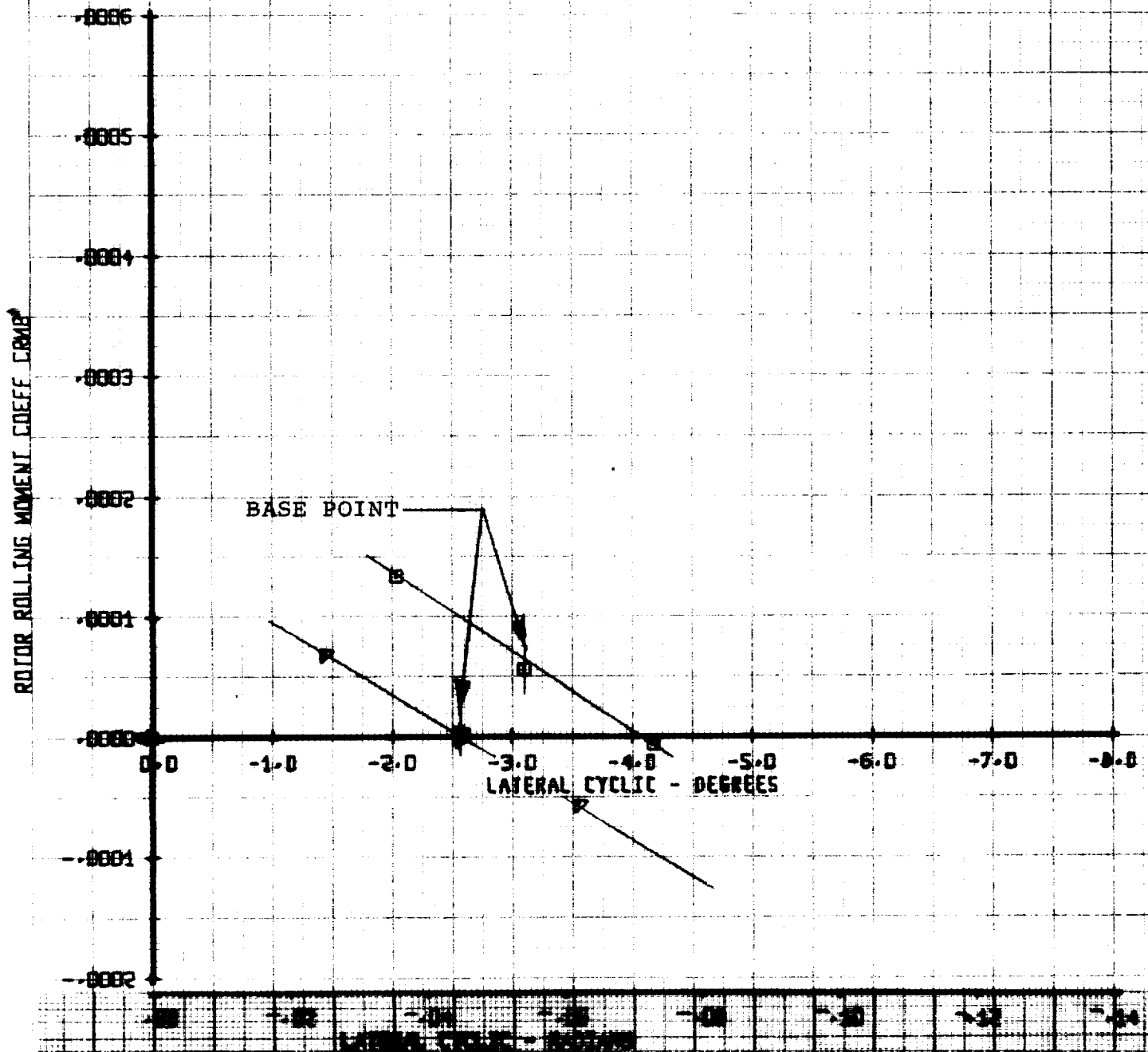


Figure C-86

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	LT'/SB	VTUN
□	32	.40	.01	.100	248
▽	32	.40	.01	.077	248

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

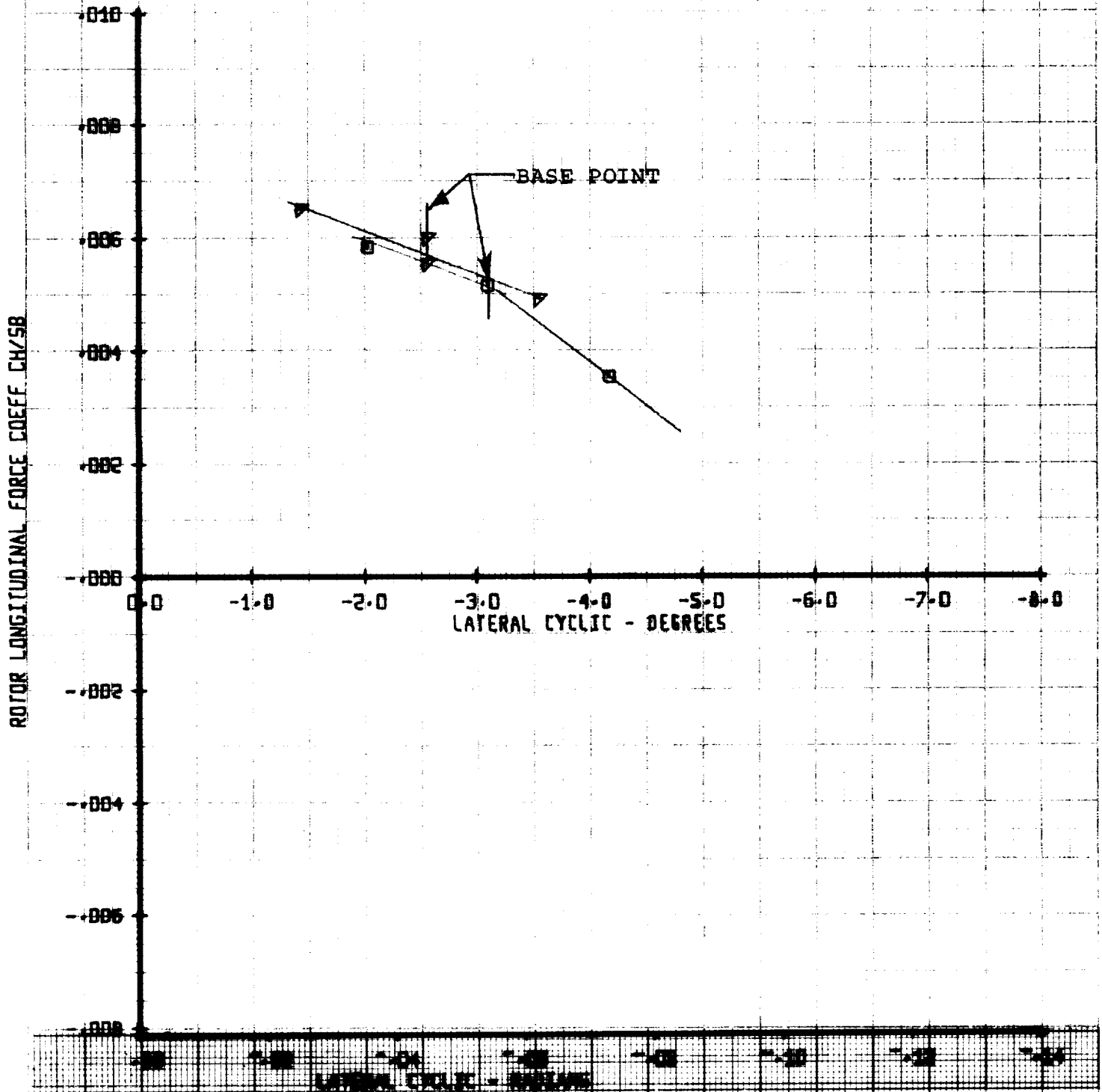


Figure C-87

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	32	.40	.01	.100	248
△	32	.40	.01	.077	248

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

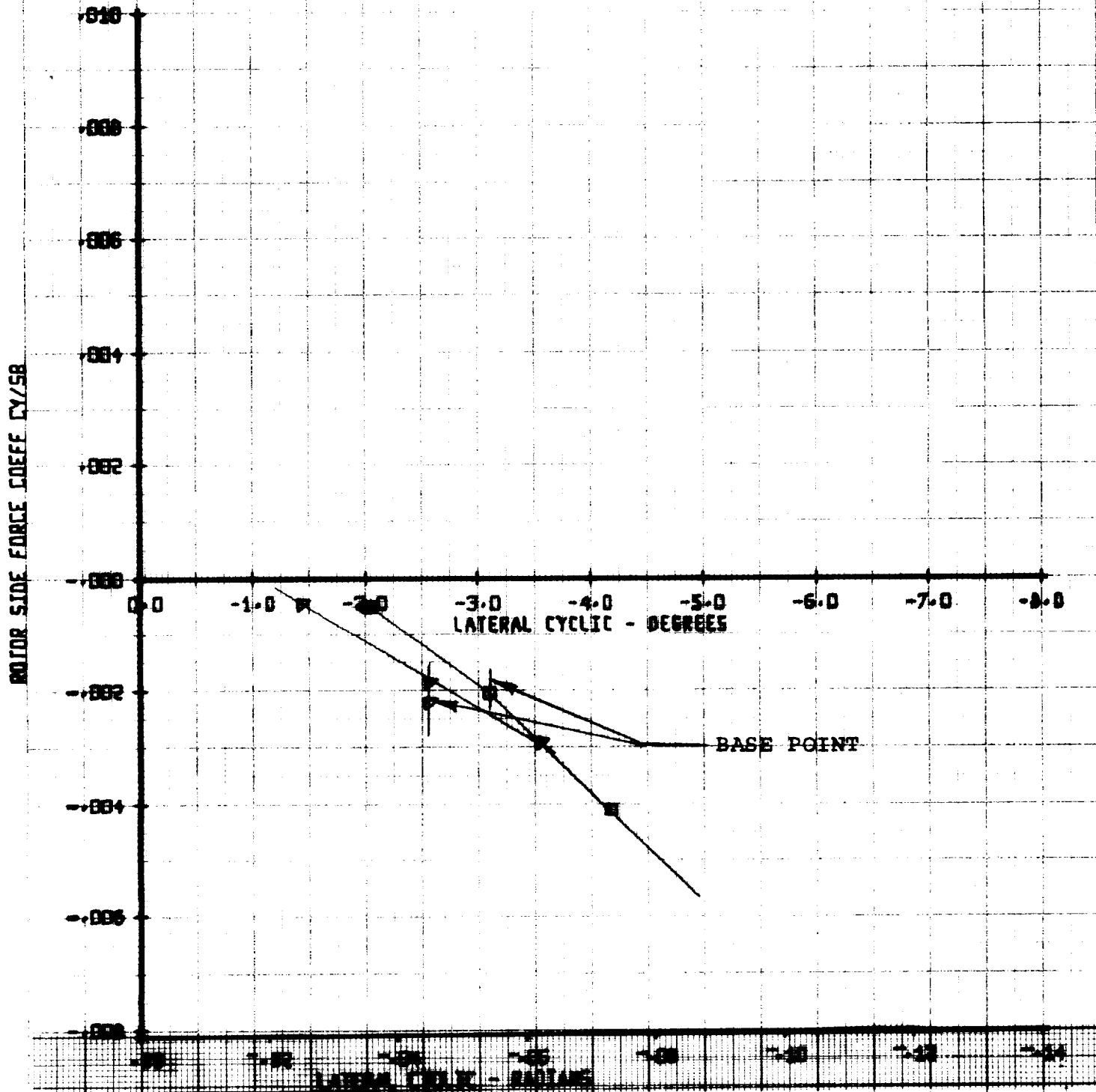


Figure C-88

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
0	32	.40	.01	.100	248
7	32	.40	.01	.077	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

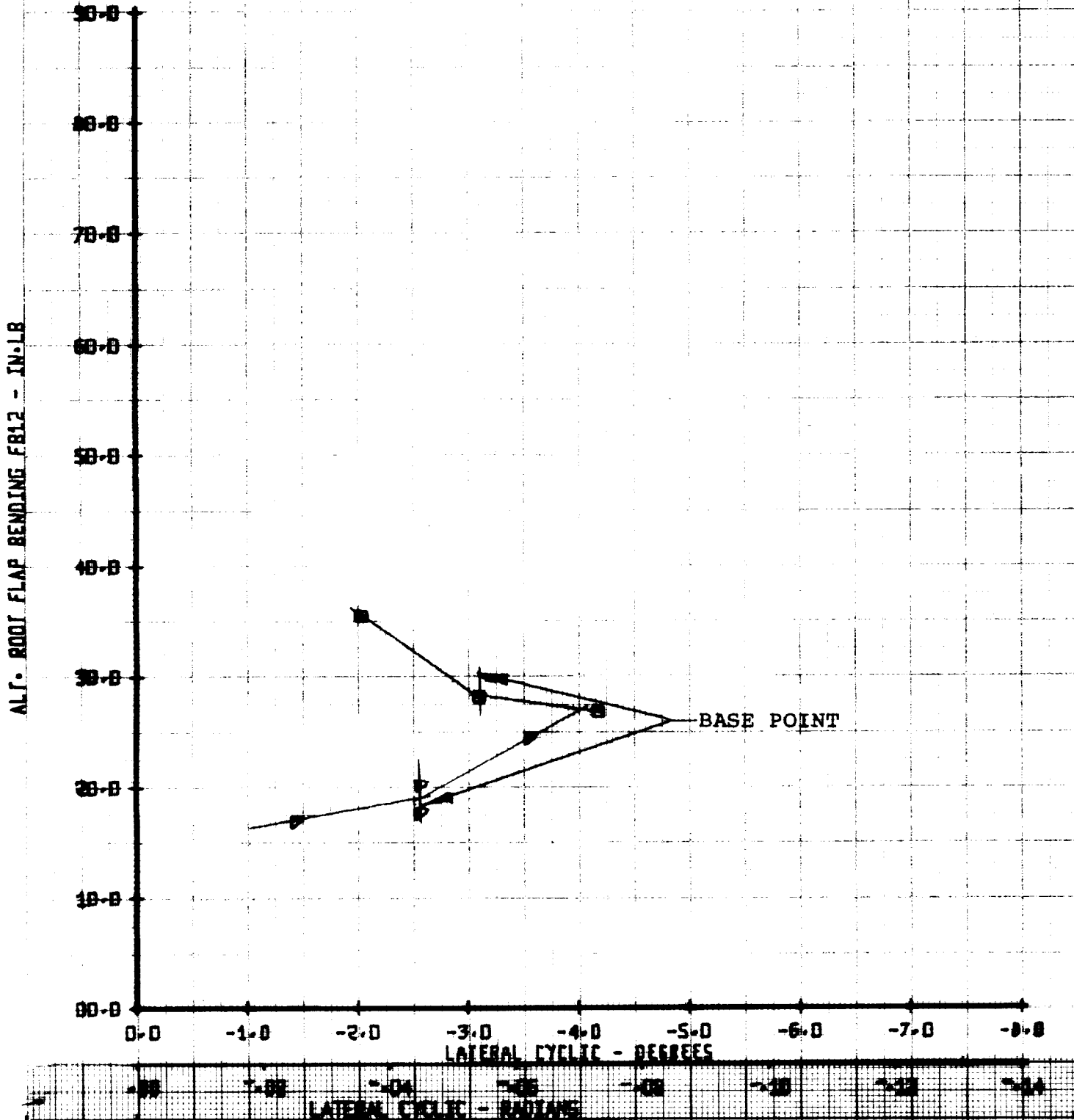


Figure C-89

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	YTUN
□	32	.40	.01	.100	248
▽	32	.40	.01	.077	248

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LATERAL CYCLIC

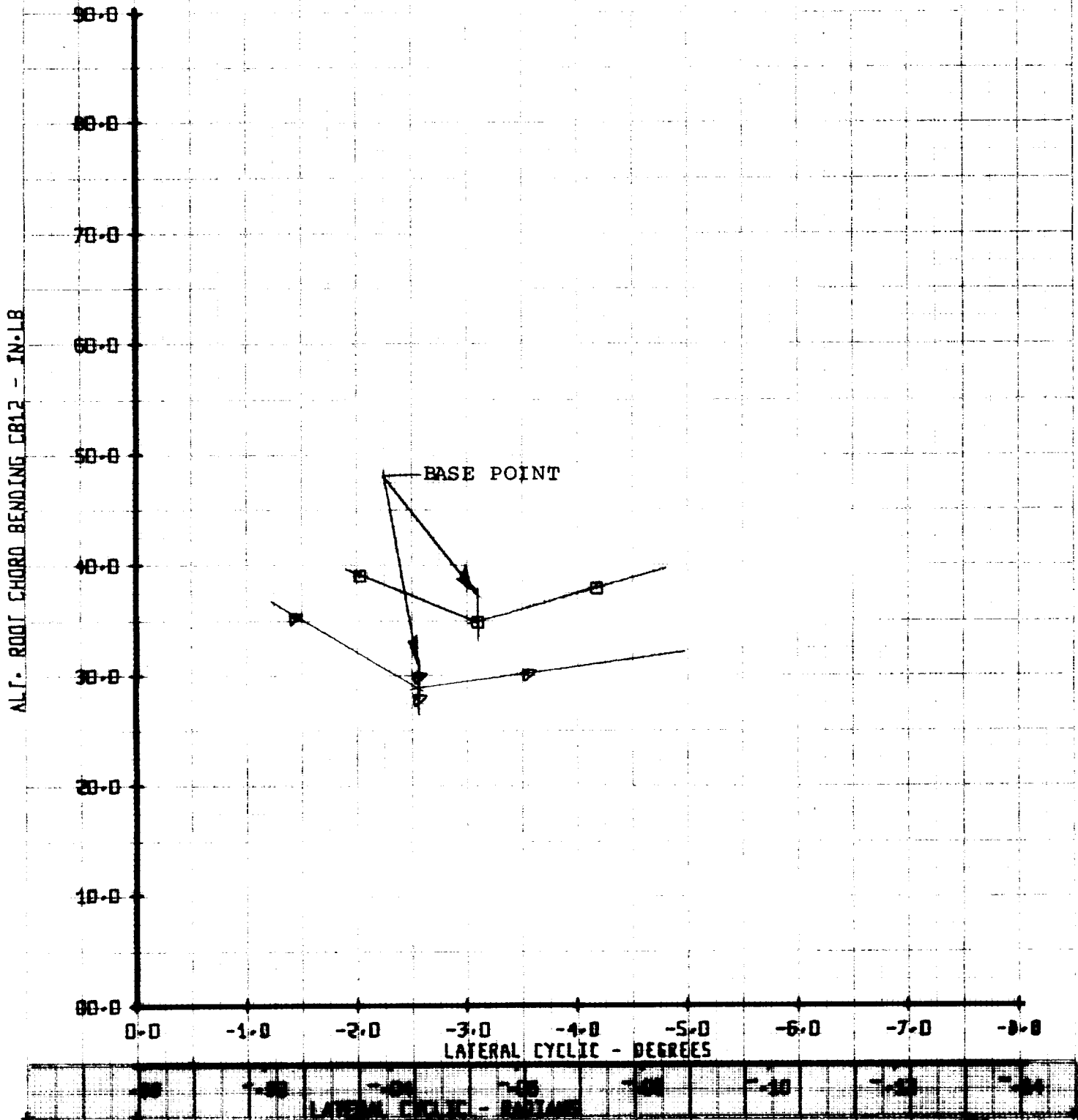


Figure C-90

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CI'/SB	VIUN
0	32	.40	.01	.100	248
8	32	.40	.01	.077	248

ALTERNATING ROOT TORSION TB12
VERSUS
LATERAL CYCLIC

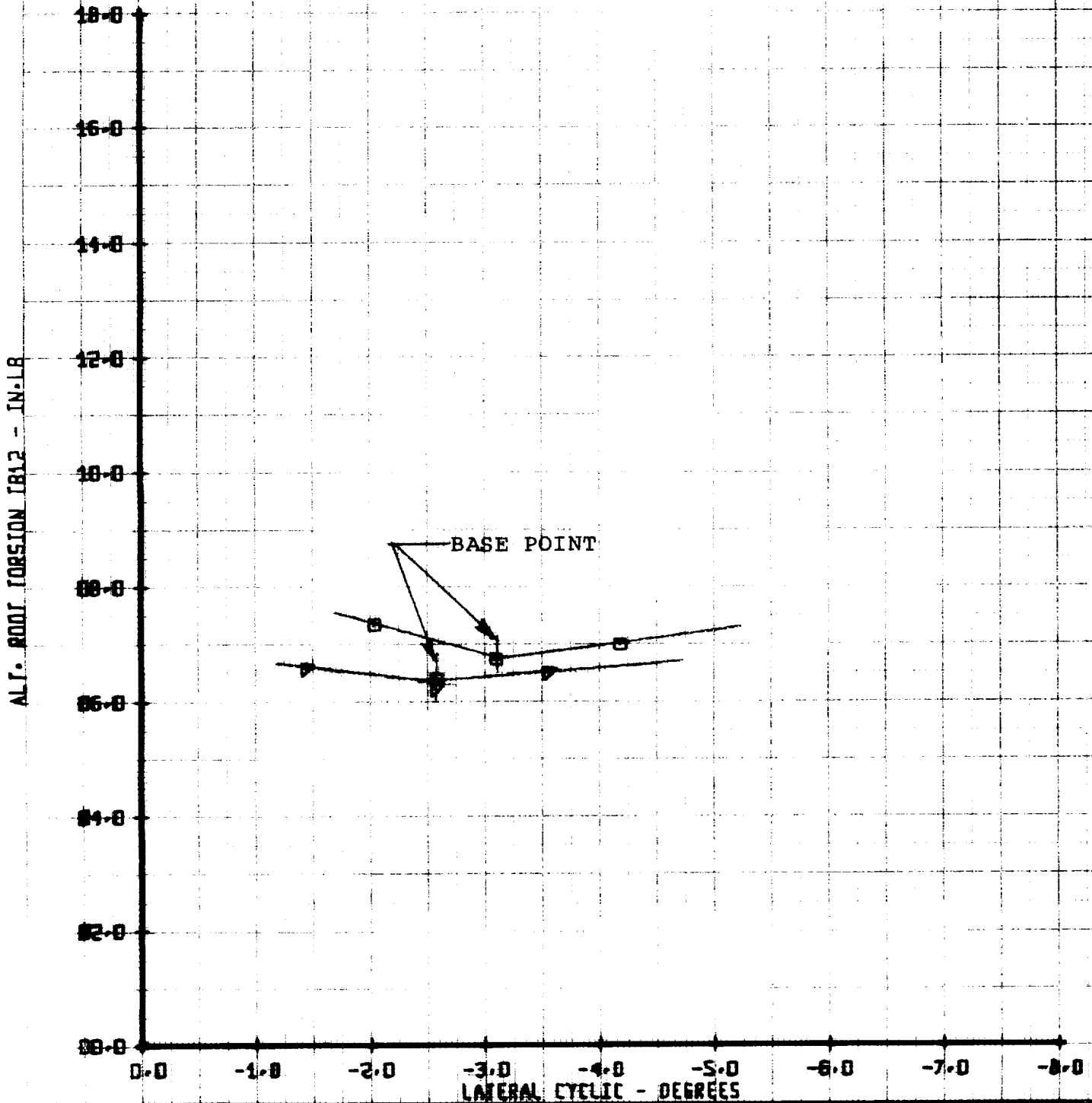


Figure C-91

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/OD2SB	CT'/SB	VTUN
□	33	.40	.10	.088	248
▽	33	.40	.10	.070	248

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC

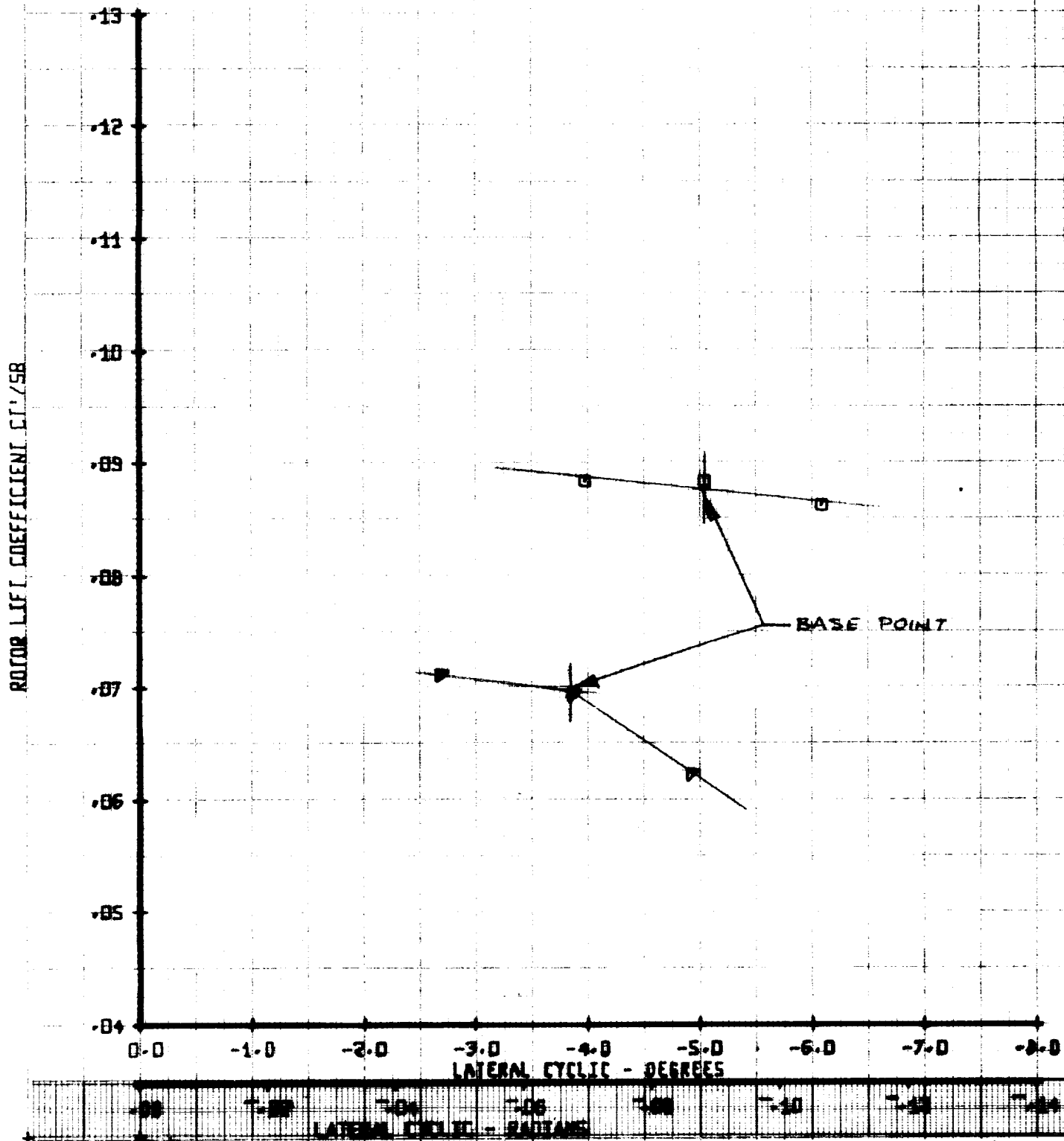


Figure C-92

LIFT-PROPULSIVE FORCE LIMIT TEST

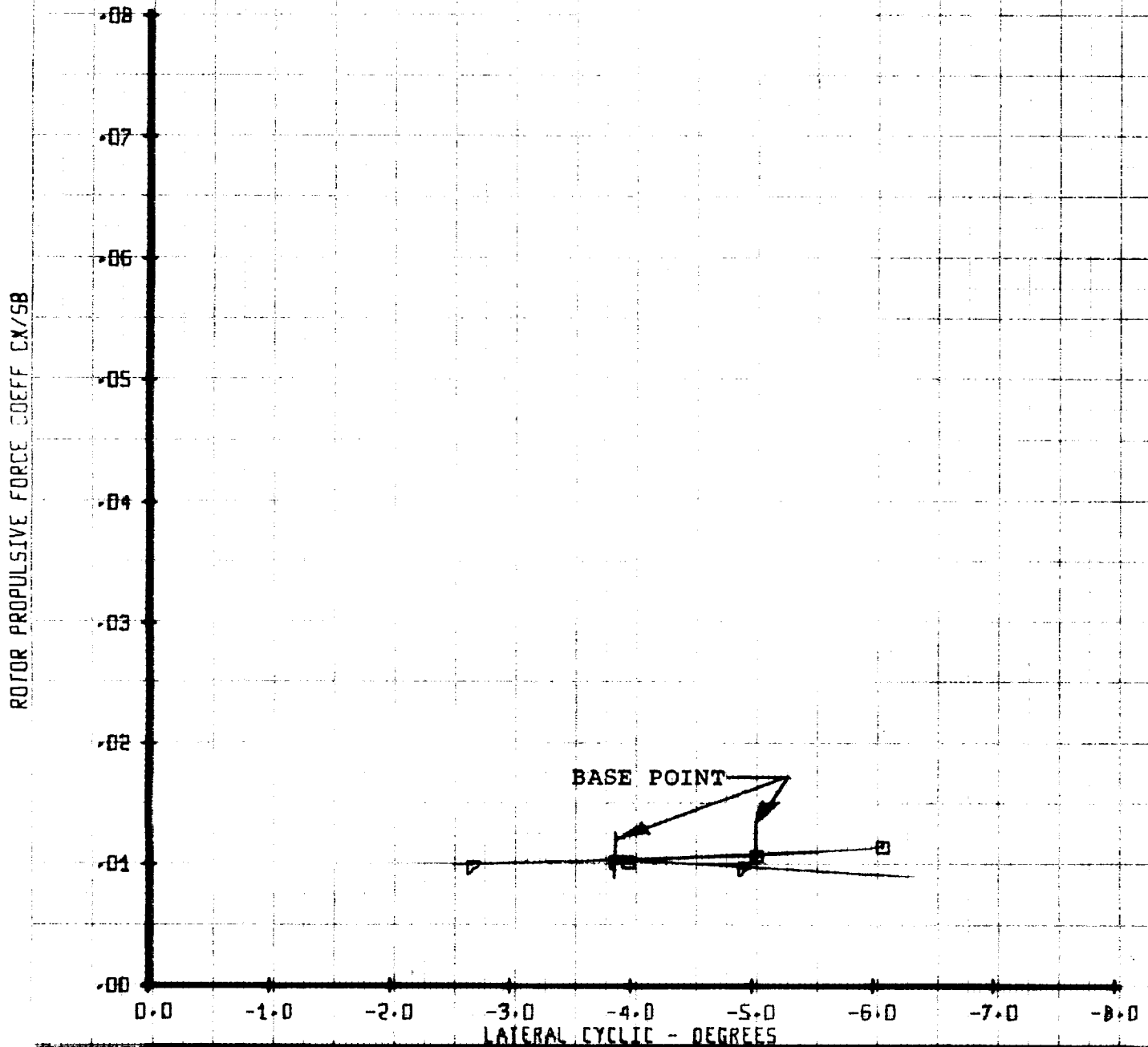
1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD2SB	CT'/SB	VTUN
□	33	.40	.10	.088	248
△	33	.40	.10	.070	248

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC



LATERAL CYCLIC - DEGREES

Figure C-93

LEFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/SB	YTUN
□	33	.40	.10	.088	248
▽	33	.40	.10	.070	248

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

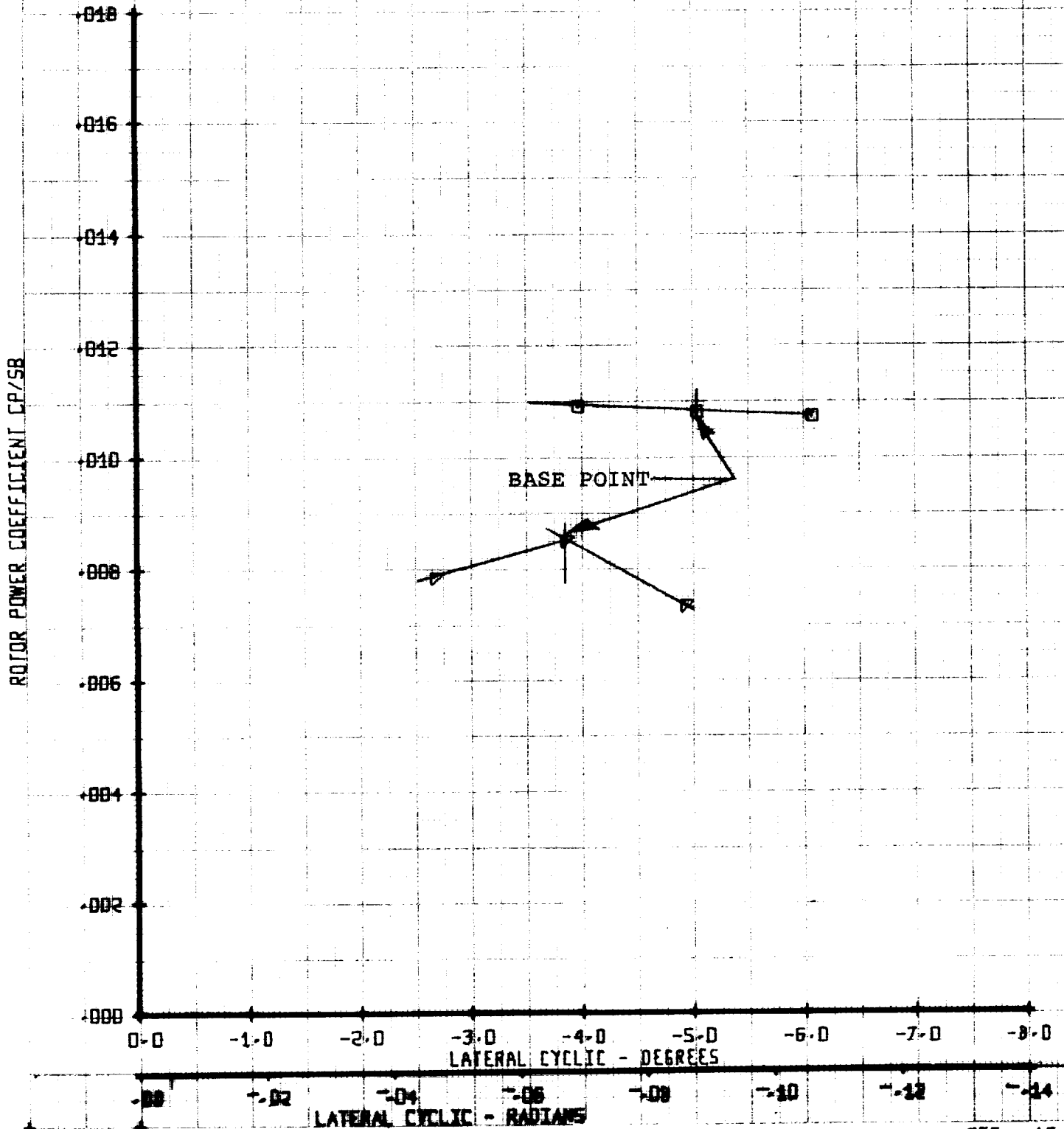


Figure C-94

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT'/SB	VTUN
□	33	.40	.10	.088	248
▽	33	.40	.10	.070	248

ROTOR PITCHING MOMENT COEFFICIENT
 VERSUS
 LATERAL CYCLIC

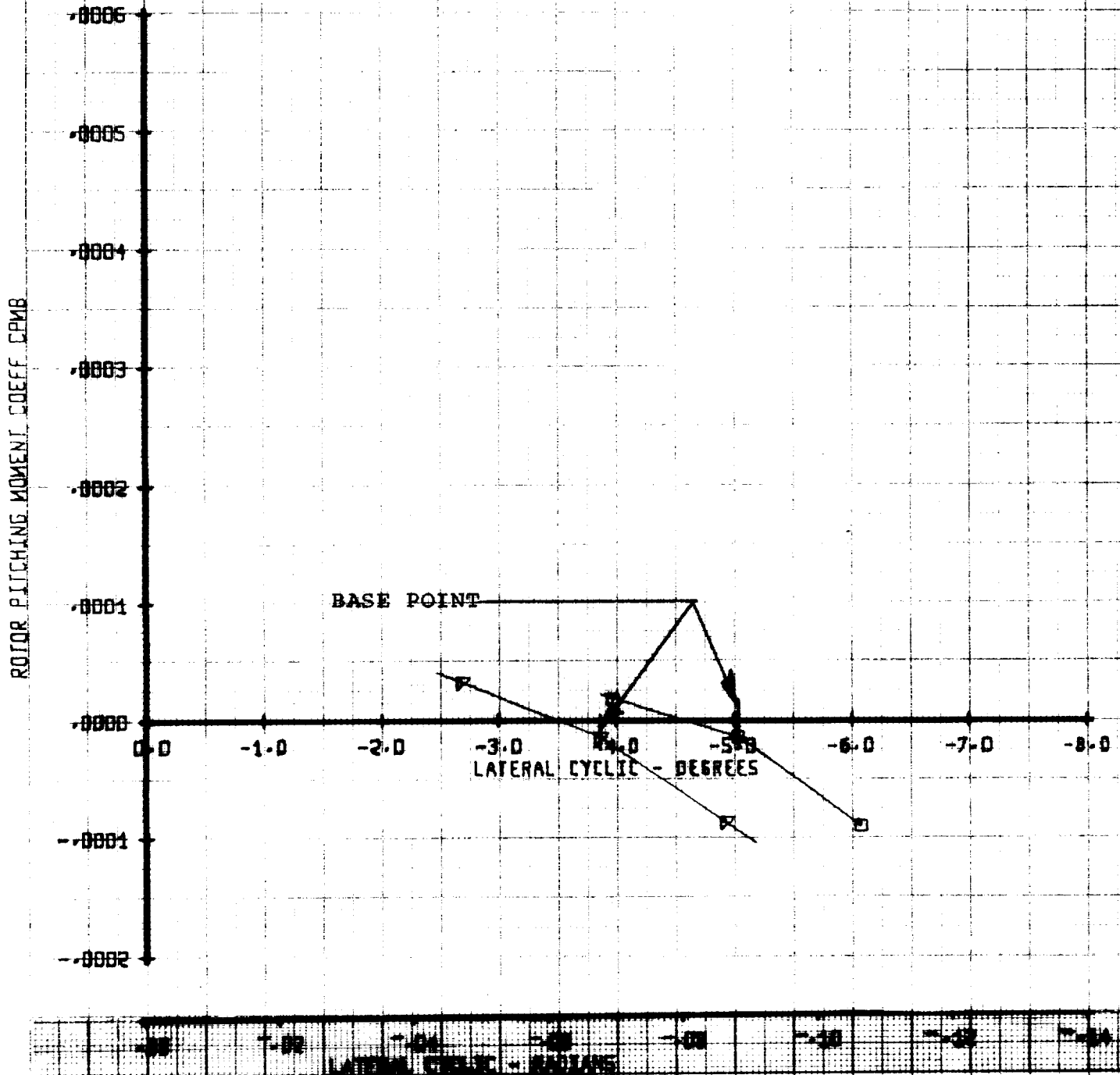


Figure C-95

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	33	.40	.10	.088	248
▽	33	.40	.10	.070	248

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

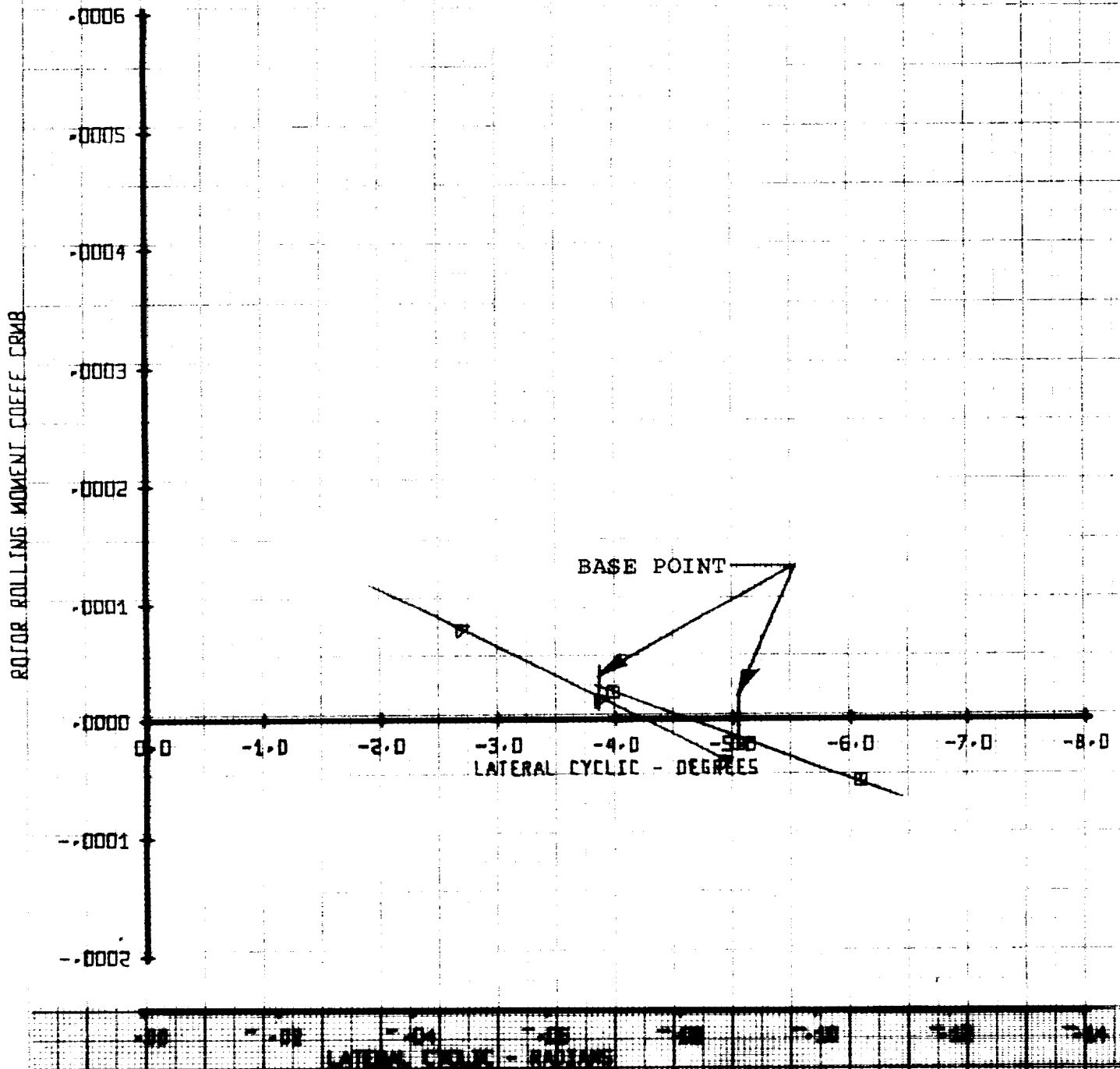


Figure C-96

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/002SB	CT'/SB	VTUN
□	33	.40	.10	.088	248
▽	33	.40	.10	.070	248

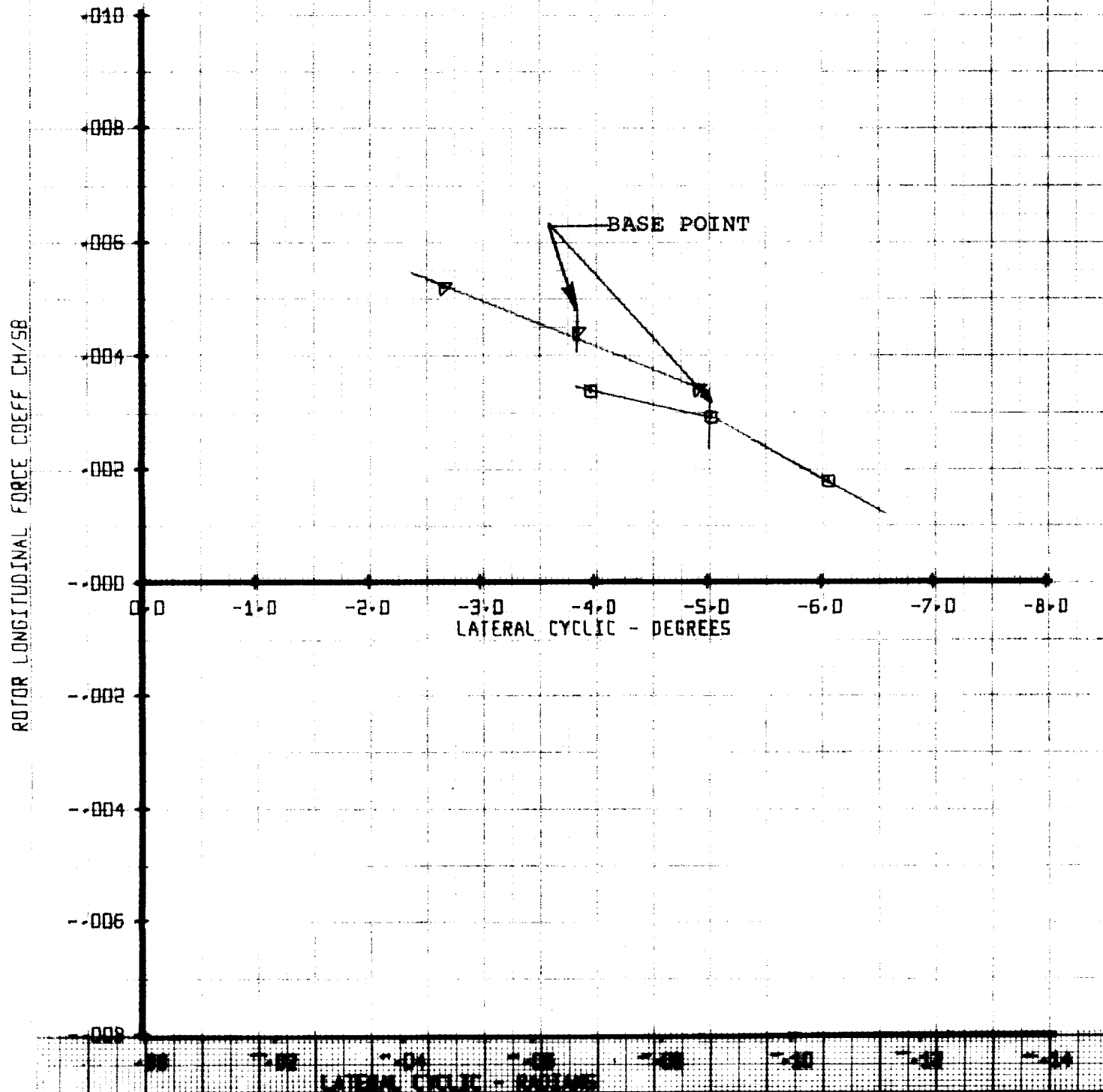
 ROTOR LONGITUDINAL FORCE COEFFICIENT
 VERSUS
 LATERAL CYCLIC


Figure C-97

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/OD258	CT/58	VTUN
0	33	.40	.10	.088	248
1	33	.40	.10	.070	248

ROTOR SIDE FORCE COEFFICIENT
 VERSUS
 LATERAL CYCLIC

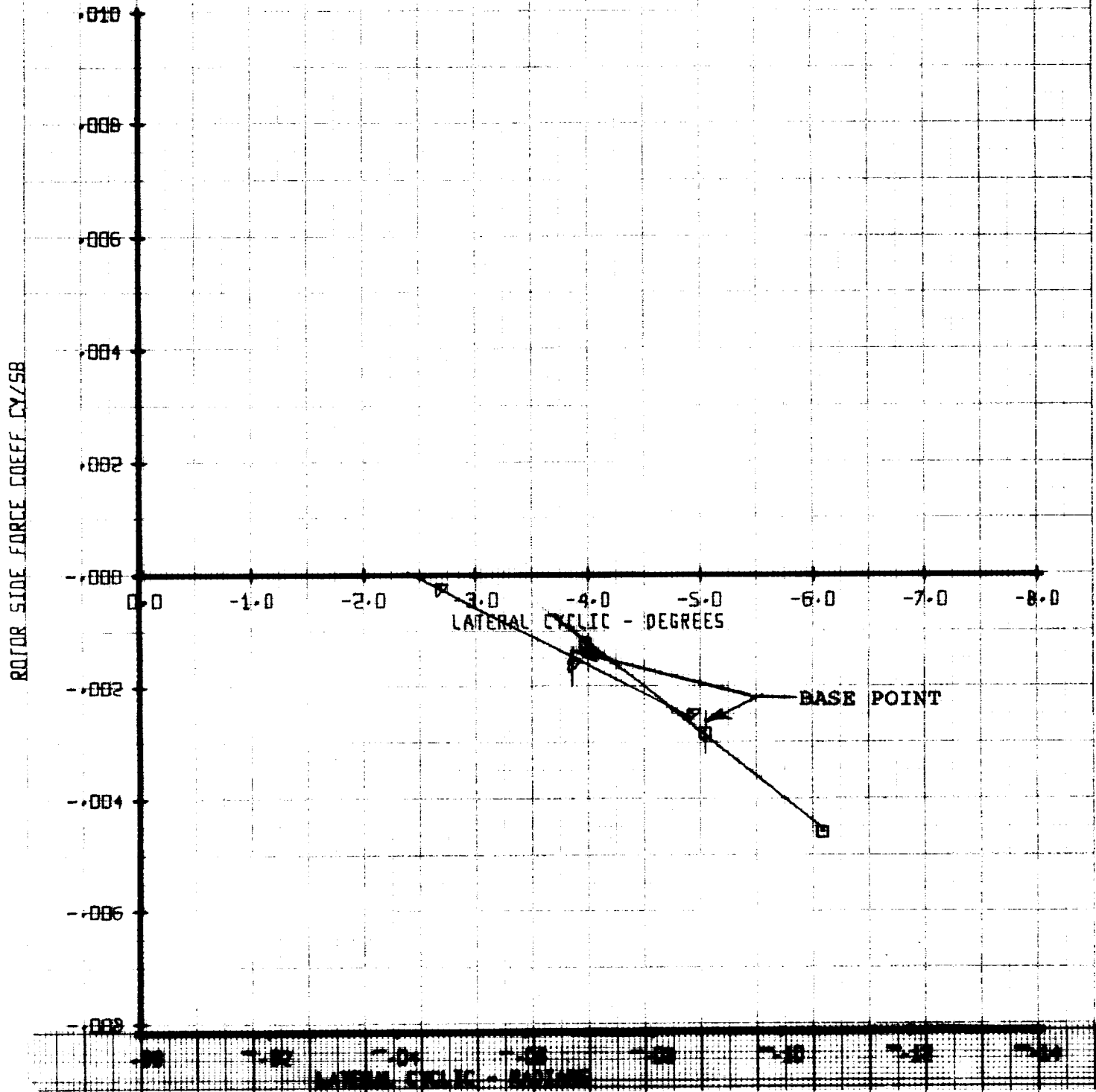


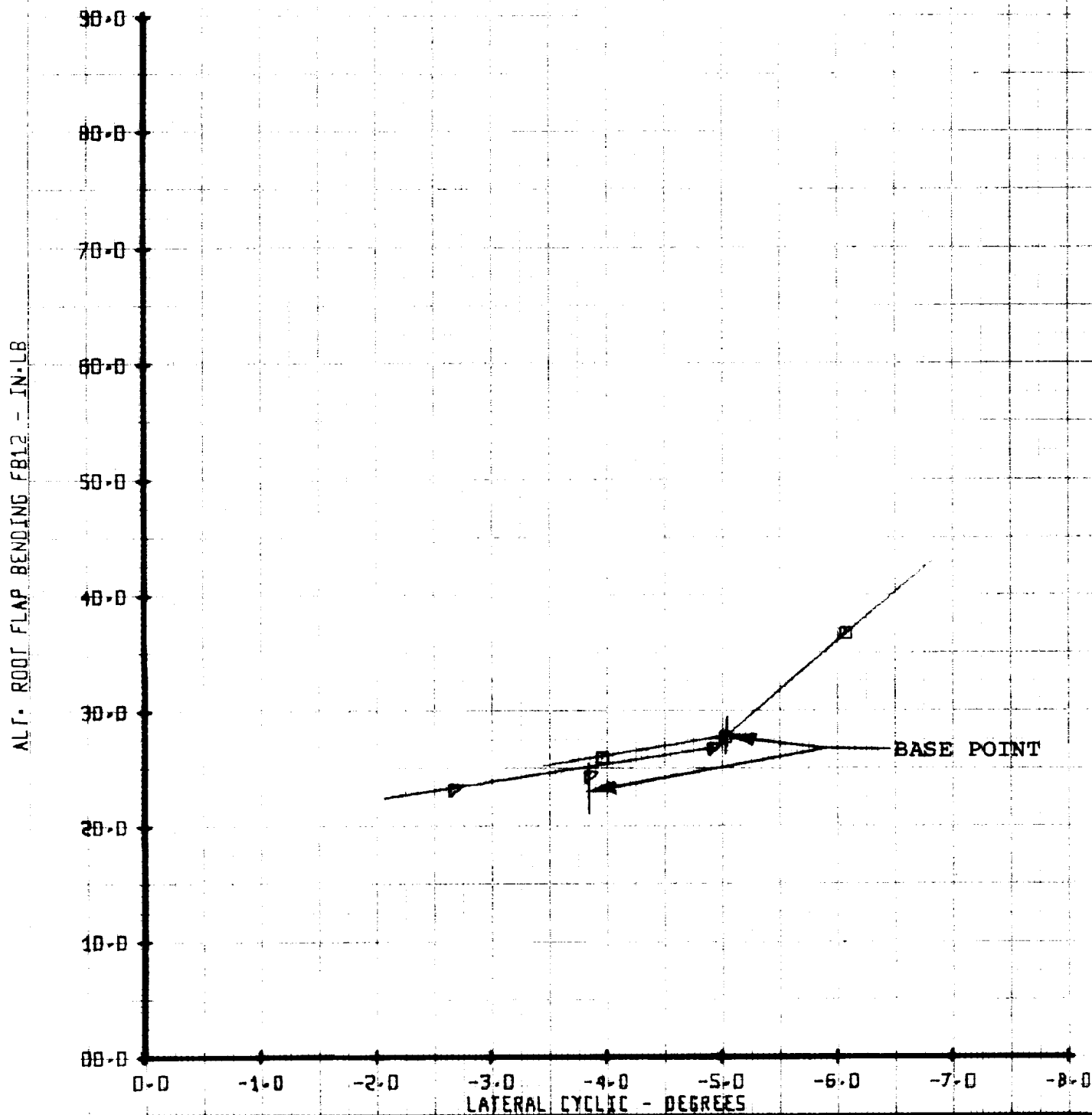
Figure C-98

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT/5B	VIUN
□	33	.40	.10	.088	248
▽	33	.40	.10	.070	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC



LATERAL CYCLIC - RADIANS

SET 17
BVMT 187

Figure C-99

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT/5B	VTUN
□	33	.40	.10	.088	24B
△	33	.40	.10	.070	24B

ALTERNATING ROOT TORSION TB12
VERSUS
LATERAL CYCLIC

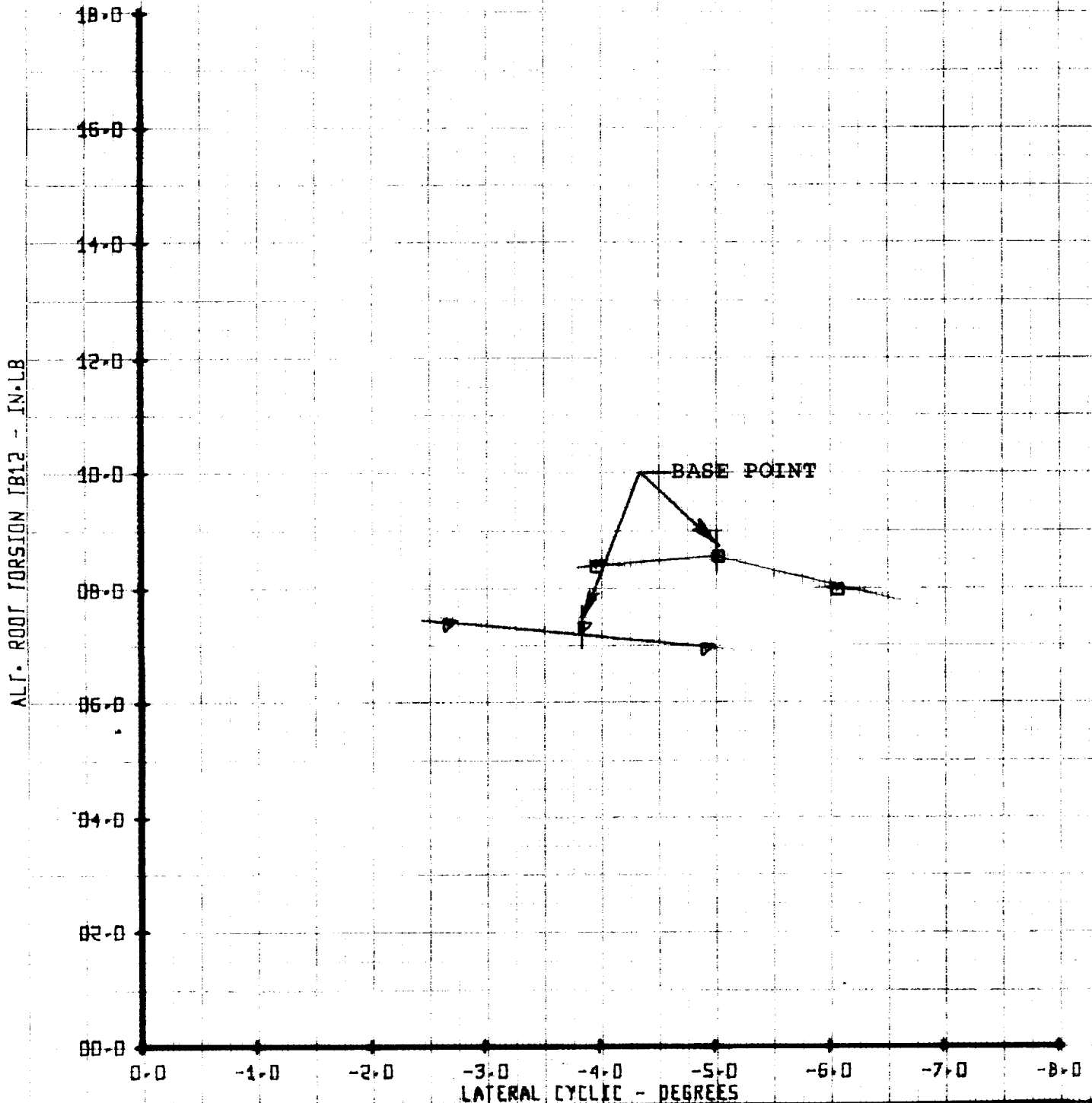


Figure C-100

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/58	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

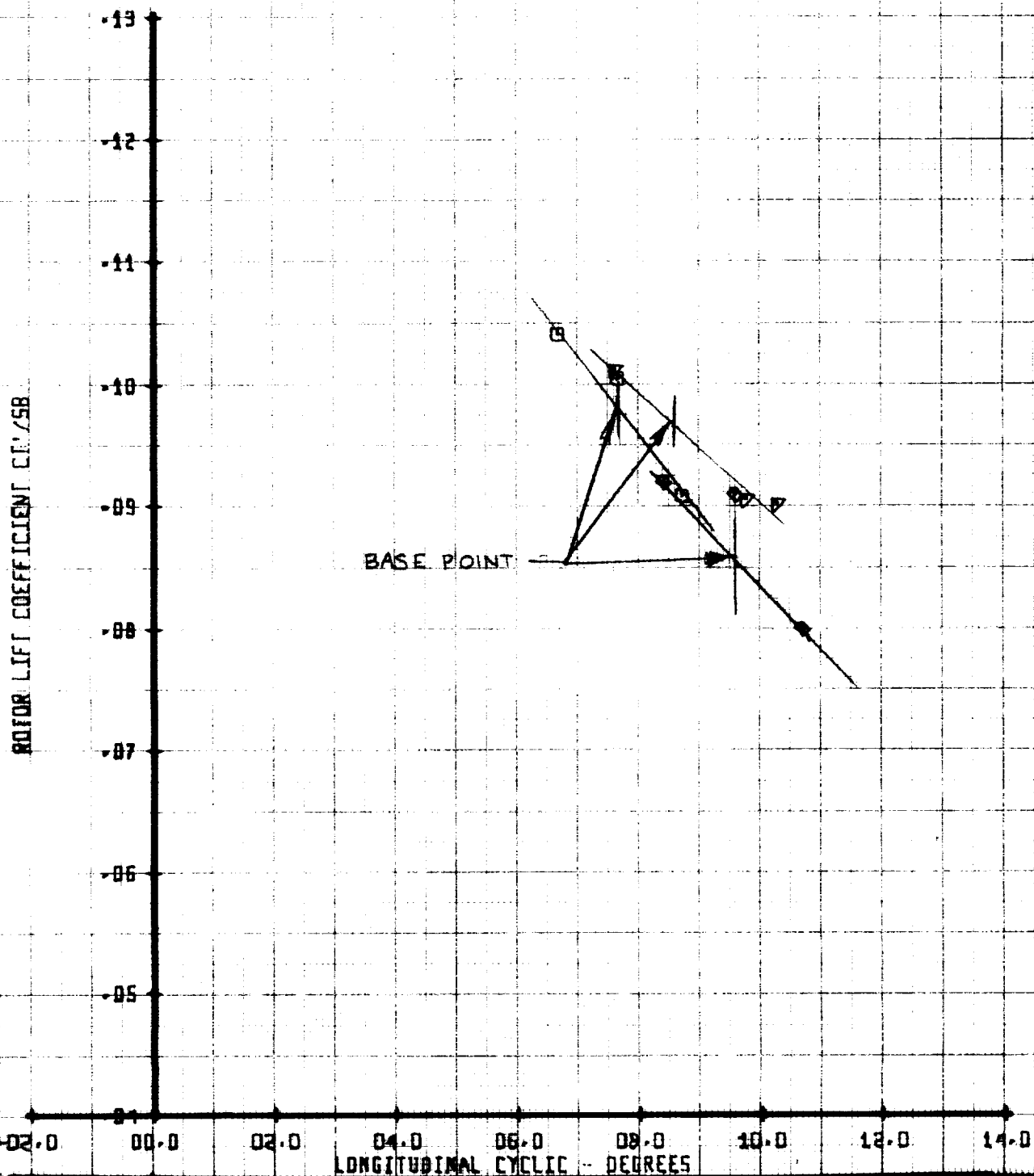
 ROTOR LIFT COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC


Figure C-101

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
◇	32	.40	.01	.100	248
◇	30	.40	.05	.095	248
◇	33	.40	.10	.098	248

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

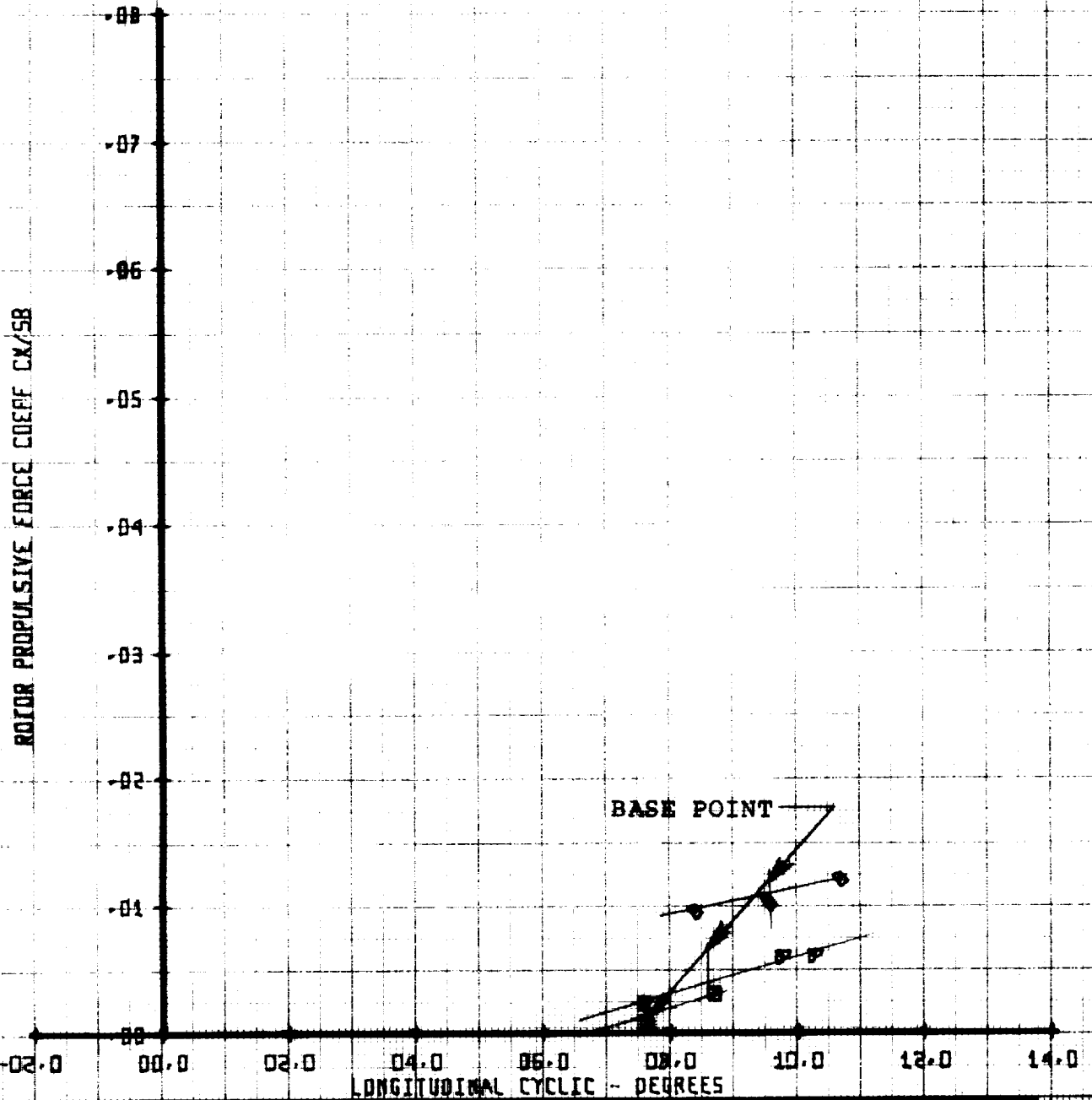


Figure C-102

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD2SB	CT'/SB	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ROTOR POWER COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

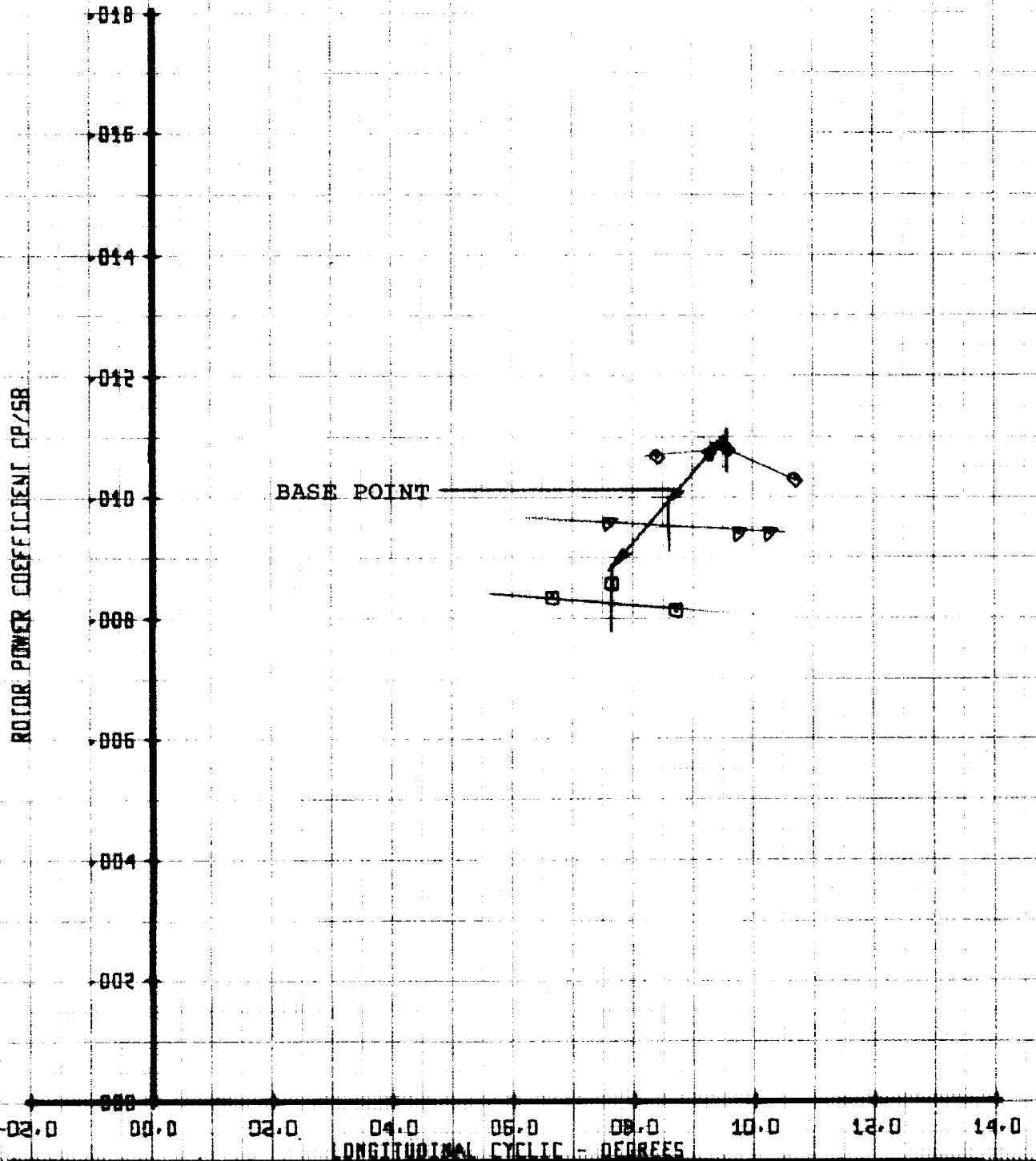


Figure C-103

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD2SB	CT/98	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

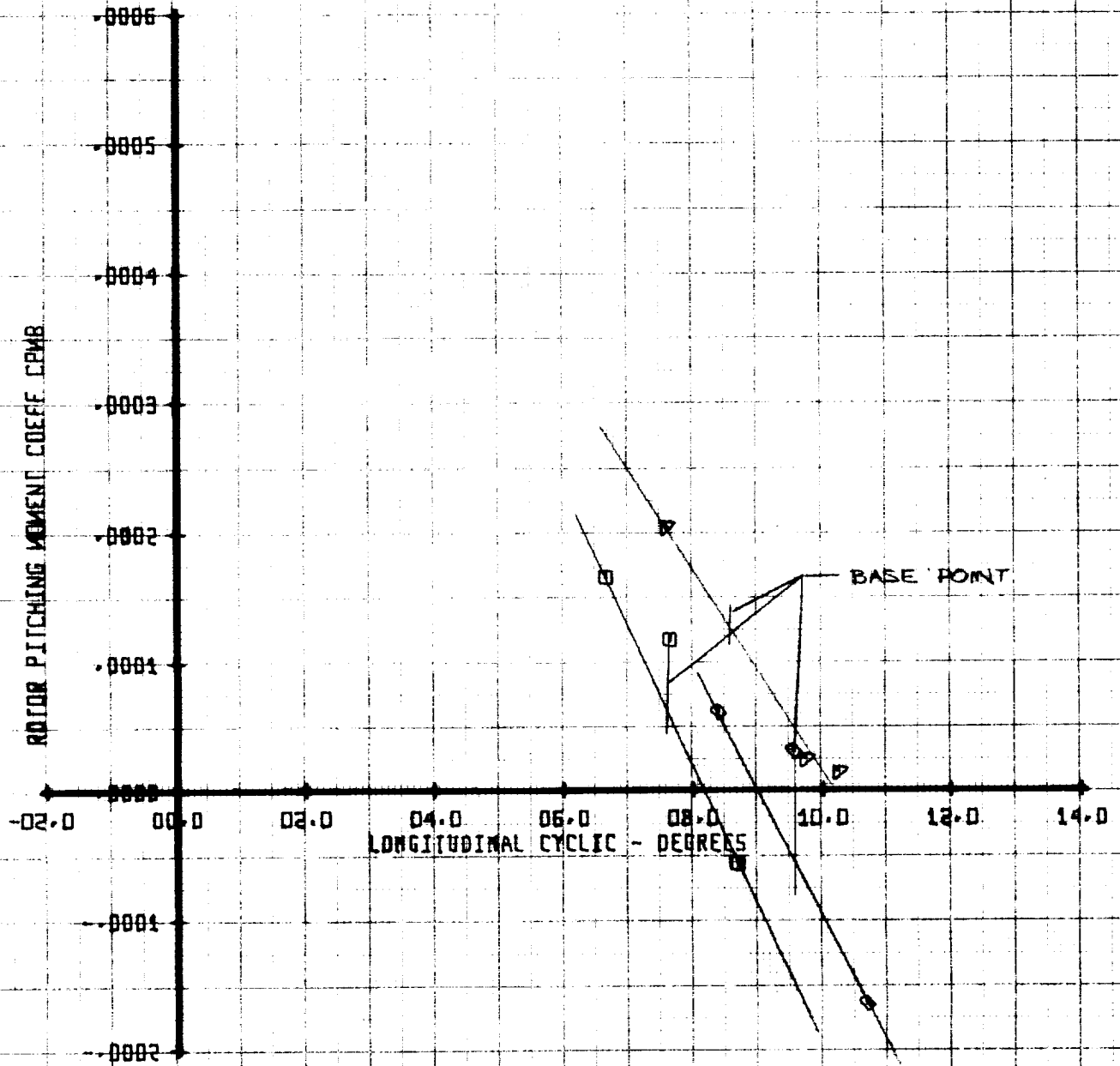


Figure C-104

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/OD2SB	CT/98	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
○	33	.40	.10	.088	248

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

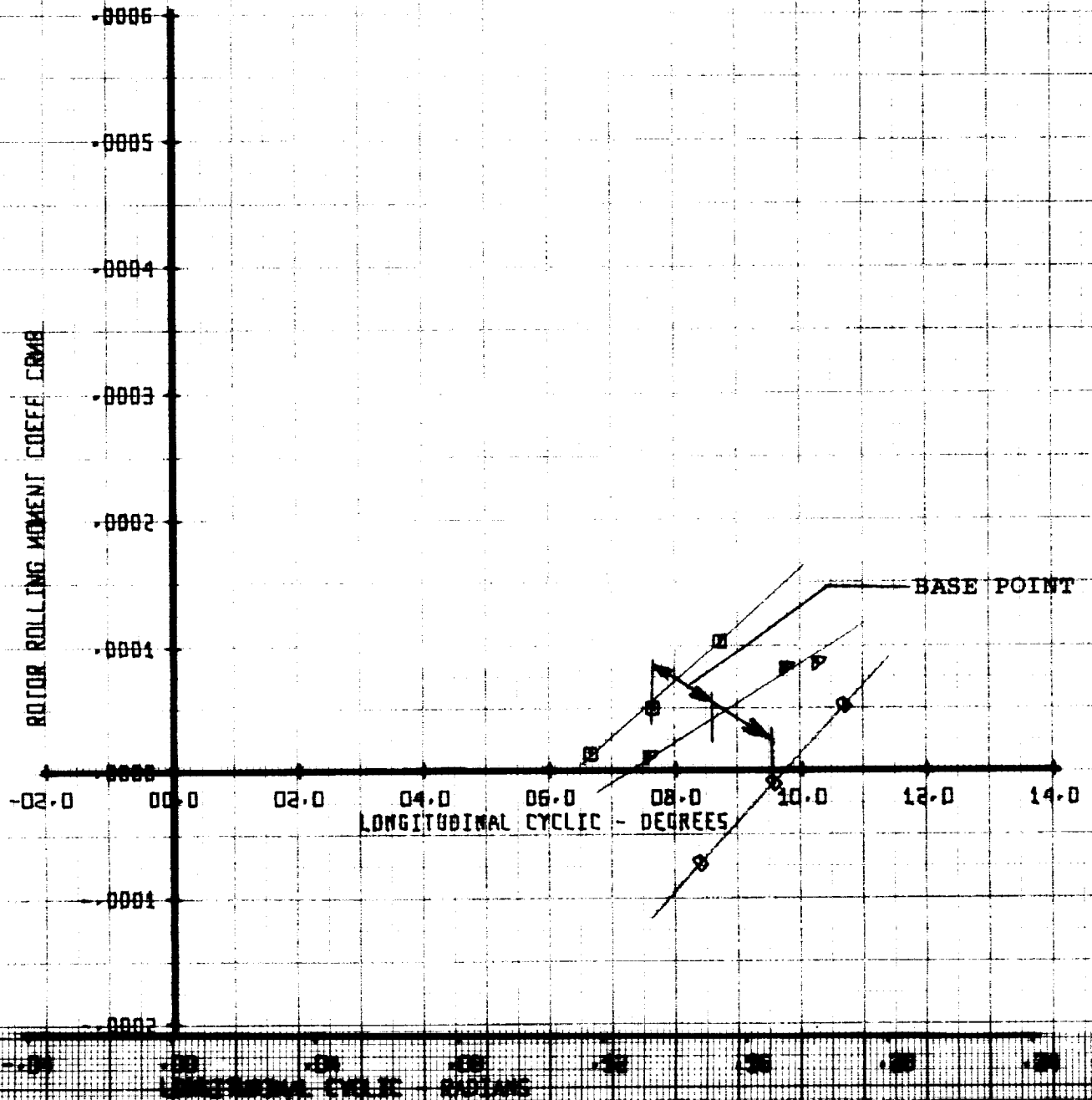


Figure C-105

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/OD2SB	CT'/SB	VTUN
G	32	.40	.01	.100	248
A	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

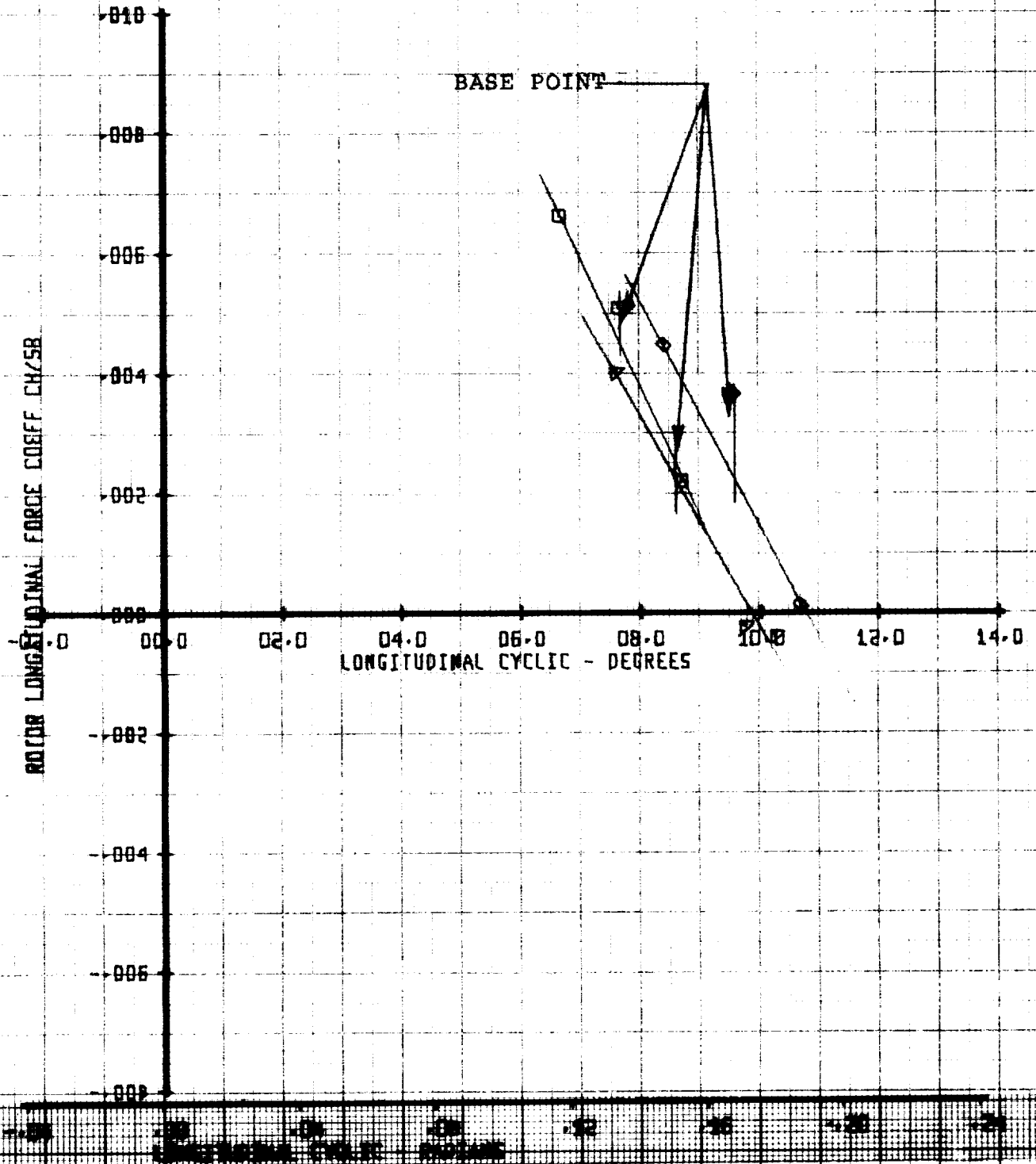


Figure C-106

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

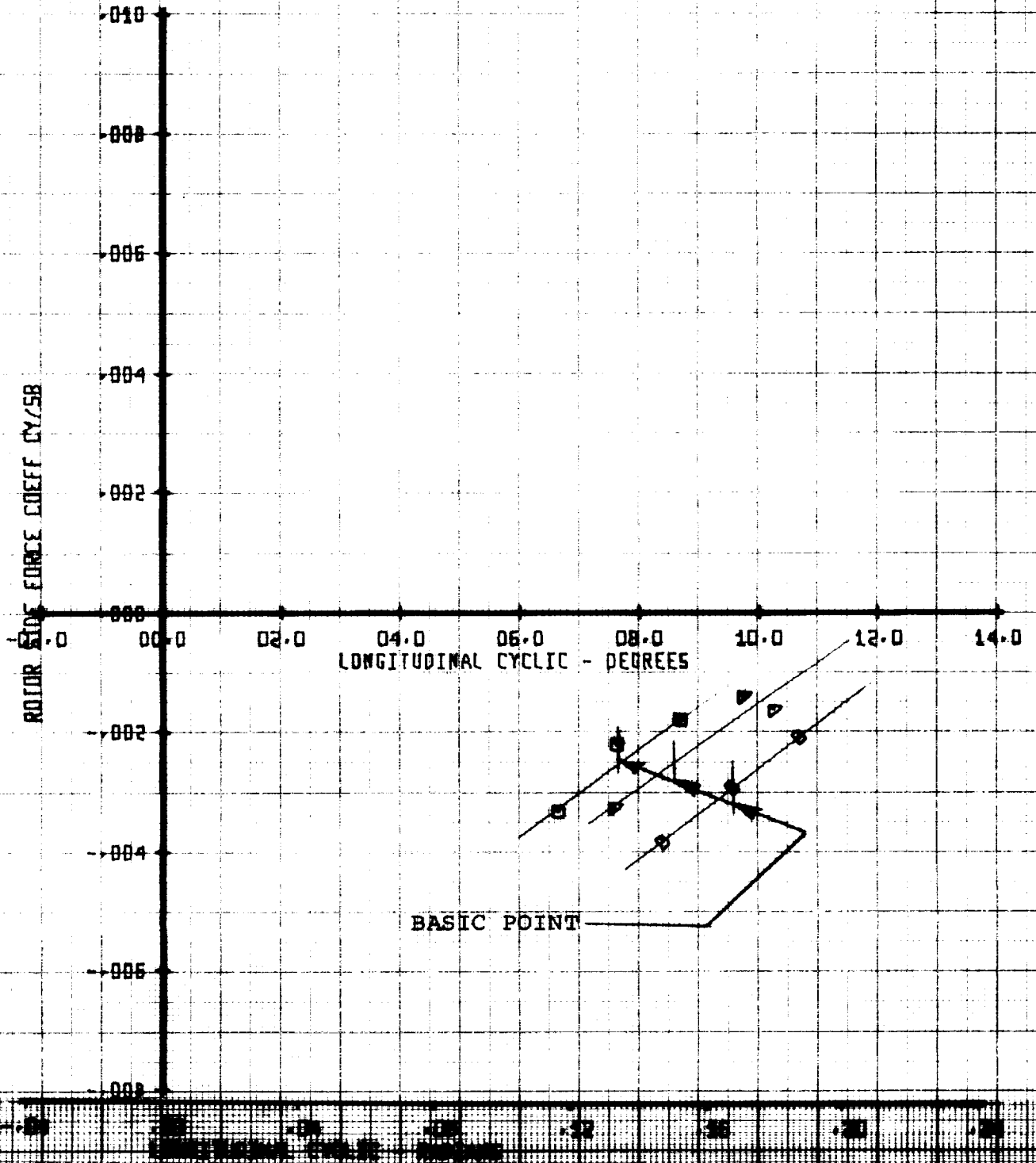


Figure C-107

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE OH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CI/58	VTUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC

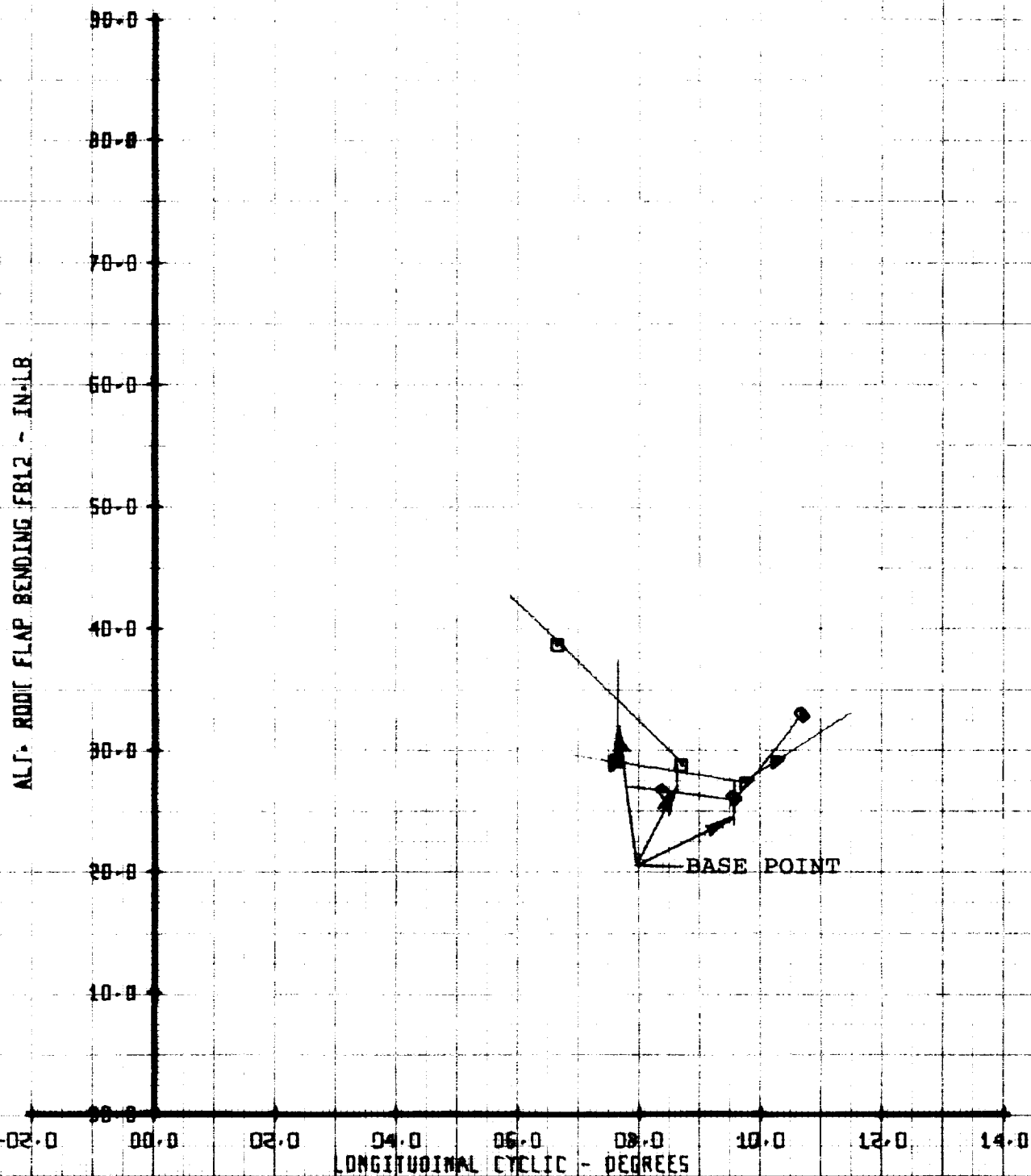


Figure C-108

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/58	VIUN
□	32	.40	.01	.100	248
△	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LONGITUDINAL CYCLIC

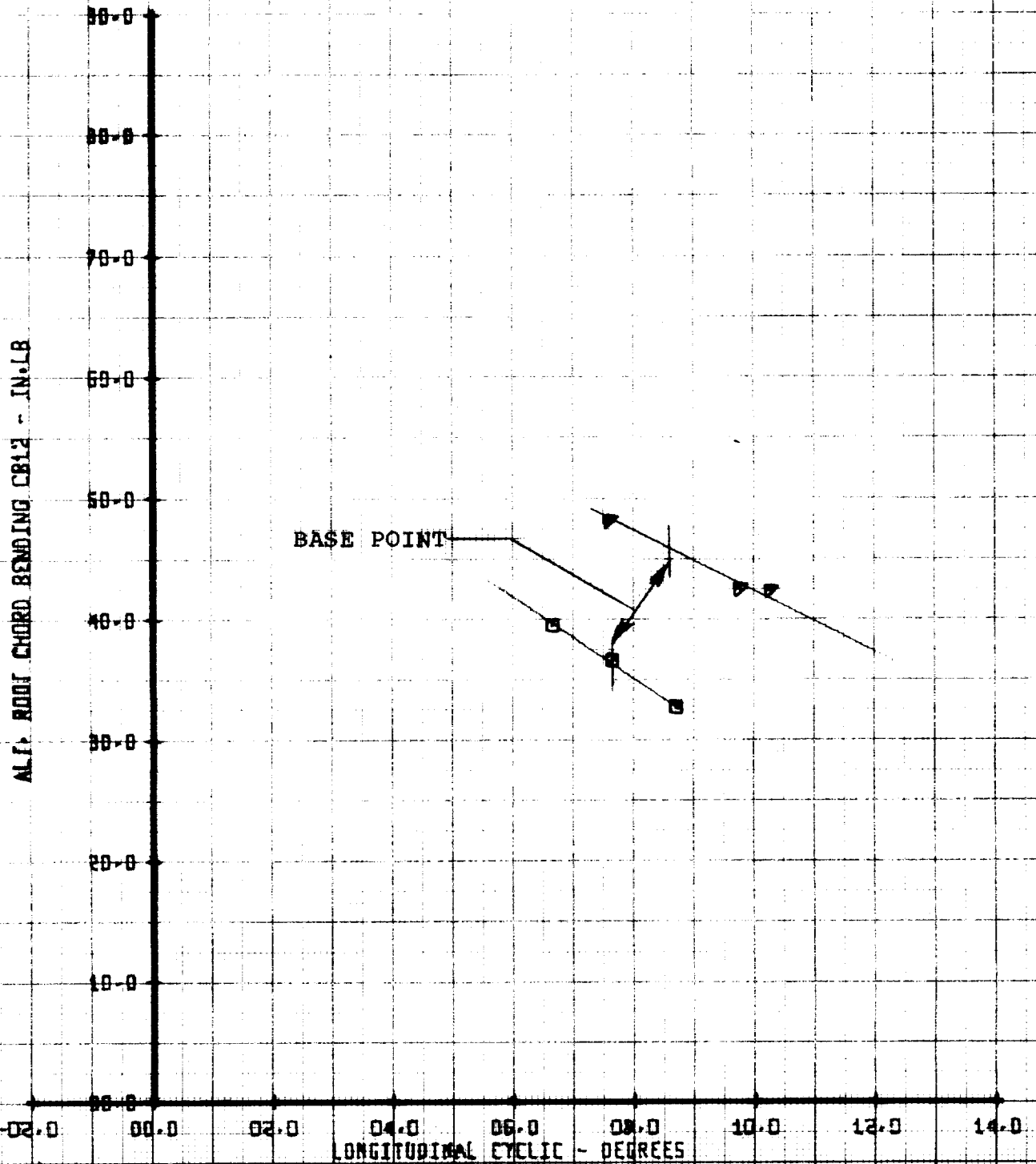


Figure C-109

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT/258	VTUN
□	32	.40	.01	.100	248
◇	30	.40	.05	.095	248
◇	33	.40	.10	.088	248

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC

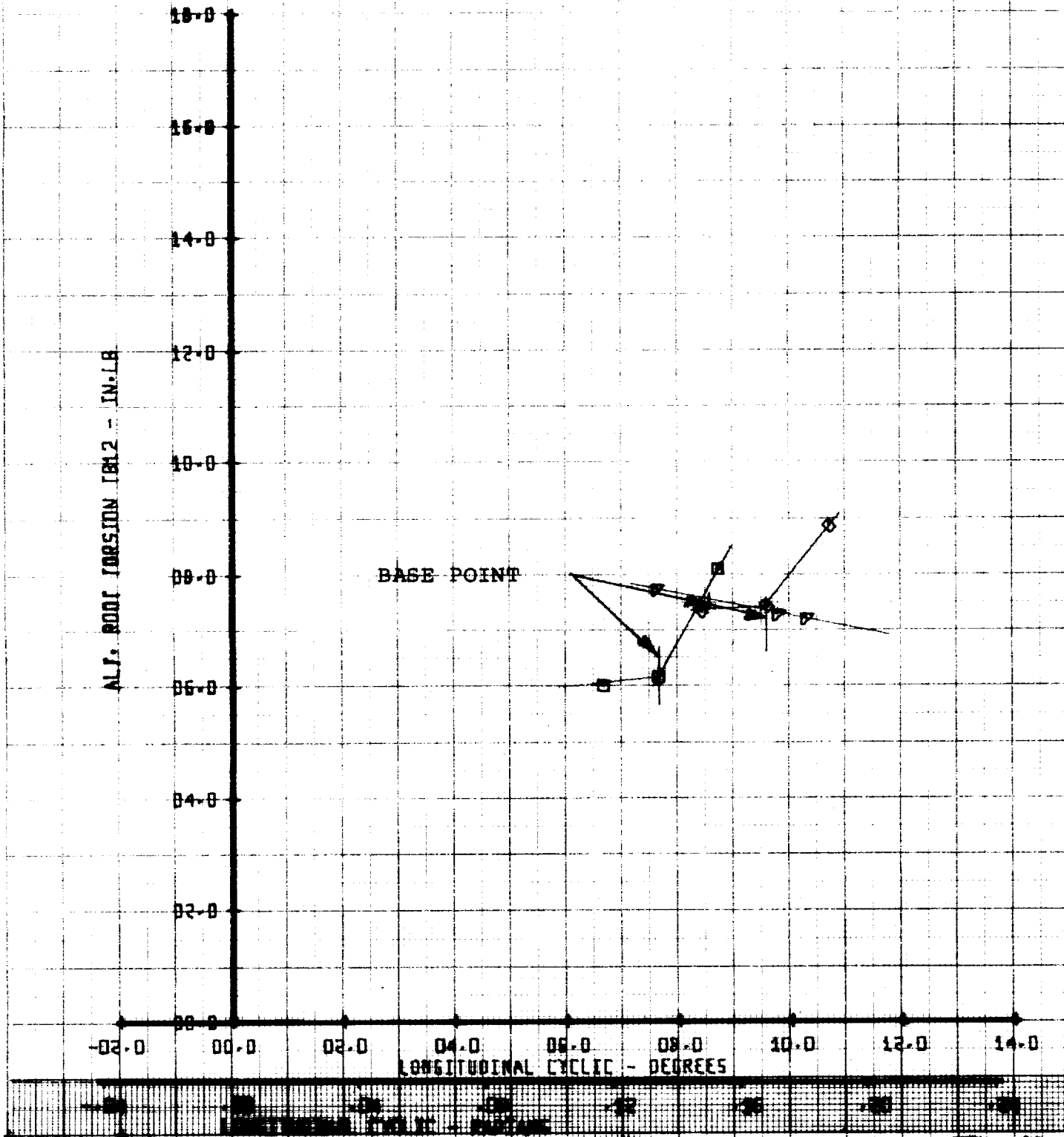


Figure 110

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CI' / 98	VTUN
□	32	.40	.01	.076	248
◇	30	.40	.05	.076	248
△	33	.40	.19	.070	248

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

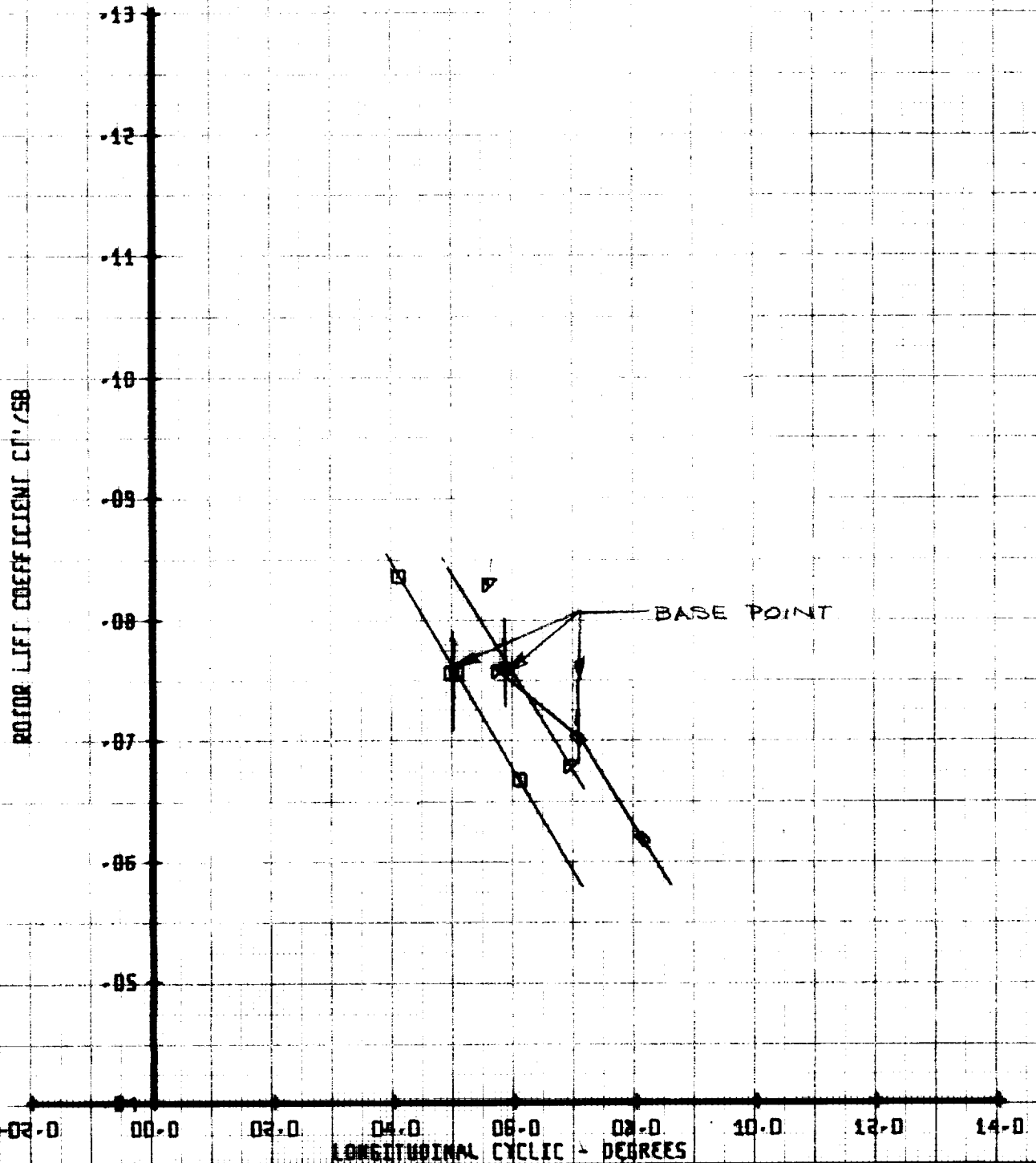


Figure C-111

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

Sym	Run	MU	X/00258	CT/98	VTUN
3	32	.40	.01	.076	248
4	30	.40	.05	.076	248
5	33	.40	.10	.070	248

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

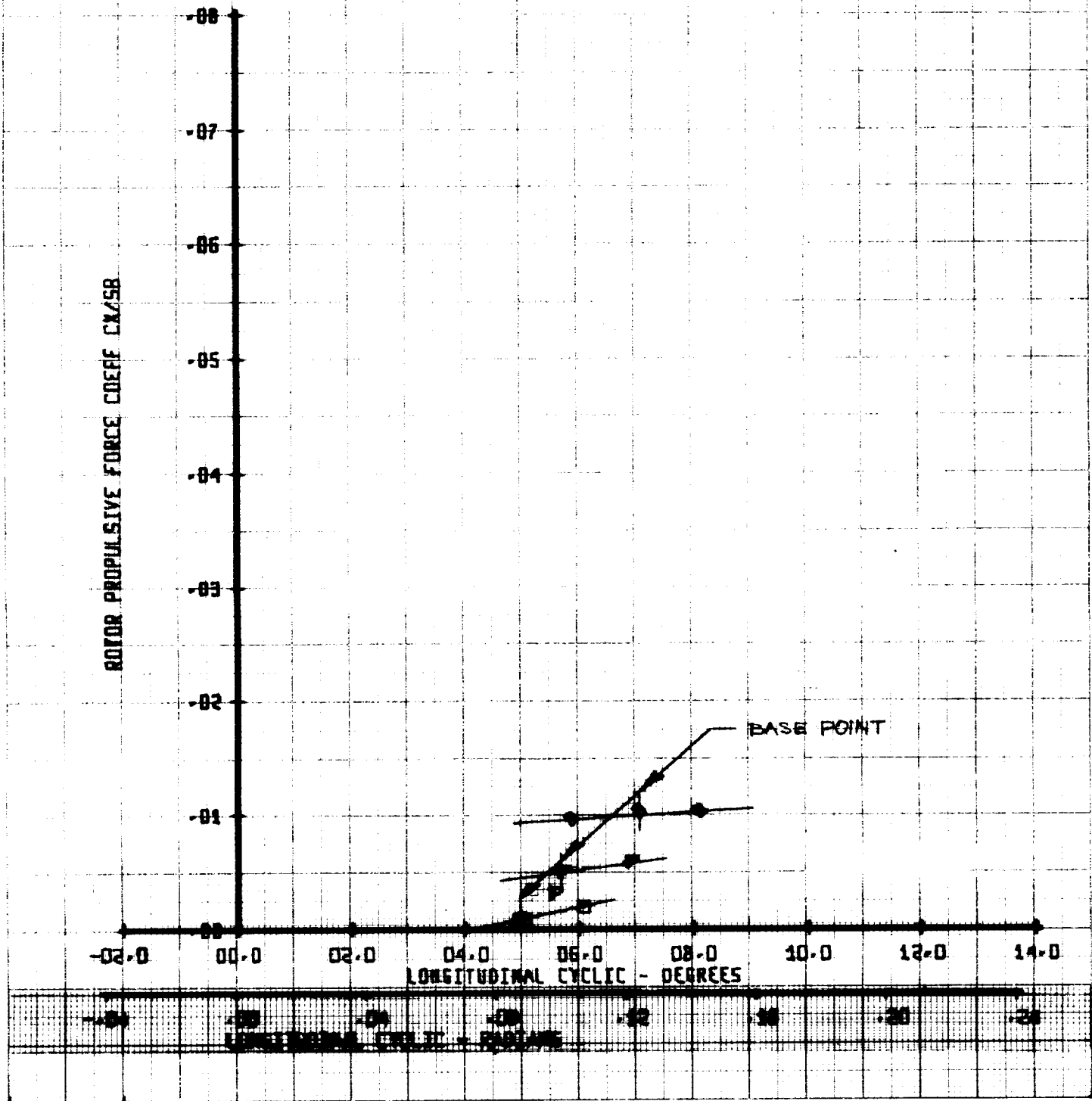


Figure C-112

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML'	X/00258	CT'/58	VTUN
□	32	.40	.01	.076	248
◇	30	.40	.05	.076	248
○	33	.40	.10	.076	248

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

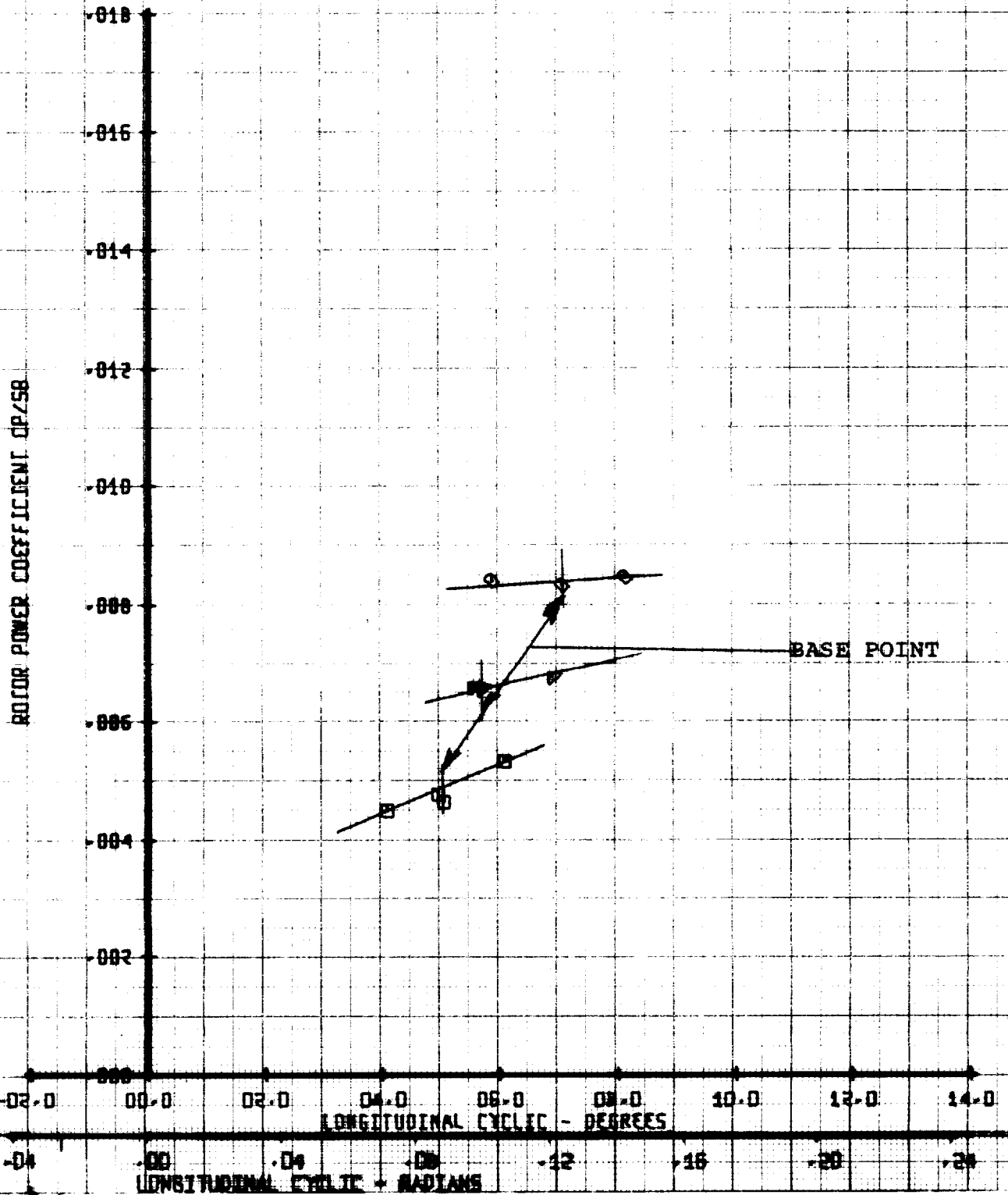


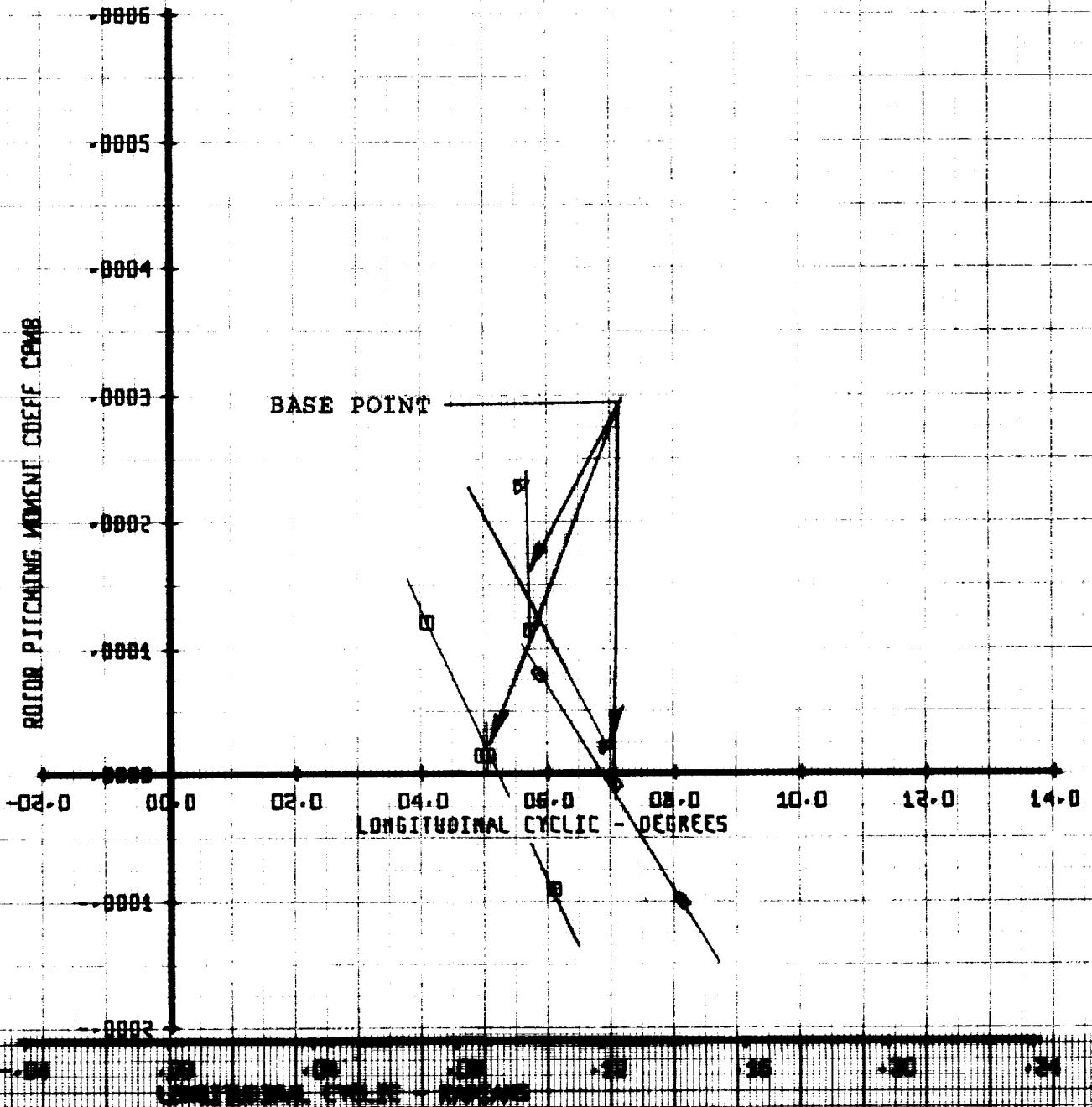
Figure C-113

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD2SB	CI'/SB	VTUN
□	32	.40	.01	.076	248
○	30	.40	.05	.076	248
◆	33	.40	.10	.070	248

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SIM	RUN	MU'	X/DP258	CT'/98	VTUM
32	32	.40	.01	.076	248
30	30	.40	.05	.076	248
33	33	.40	.10	.076	248

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

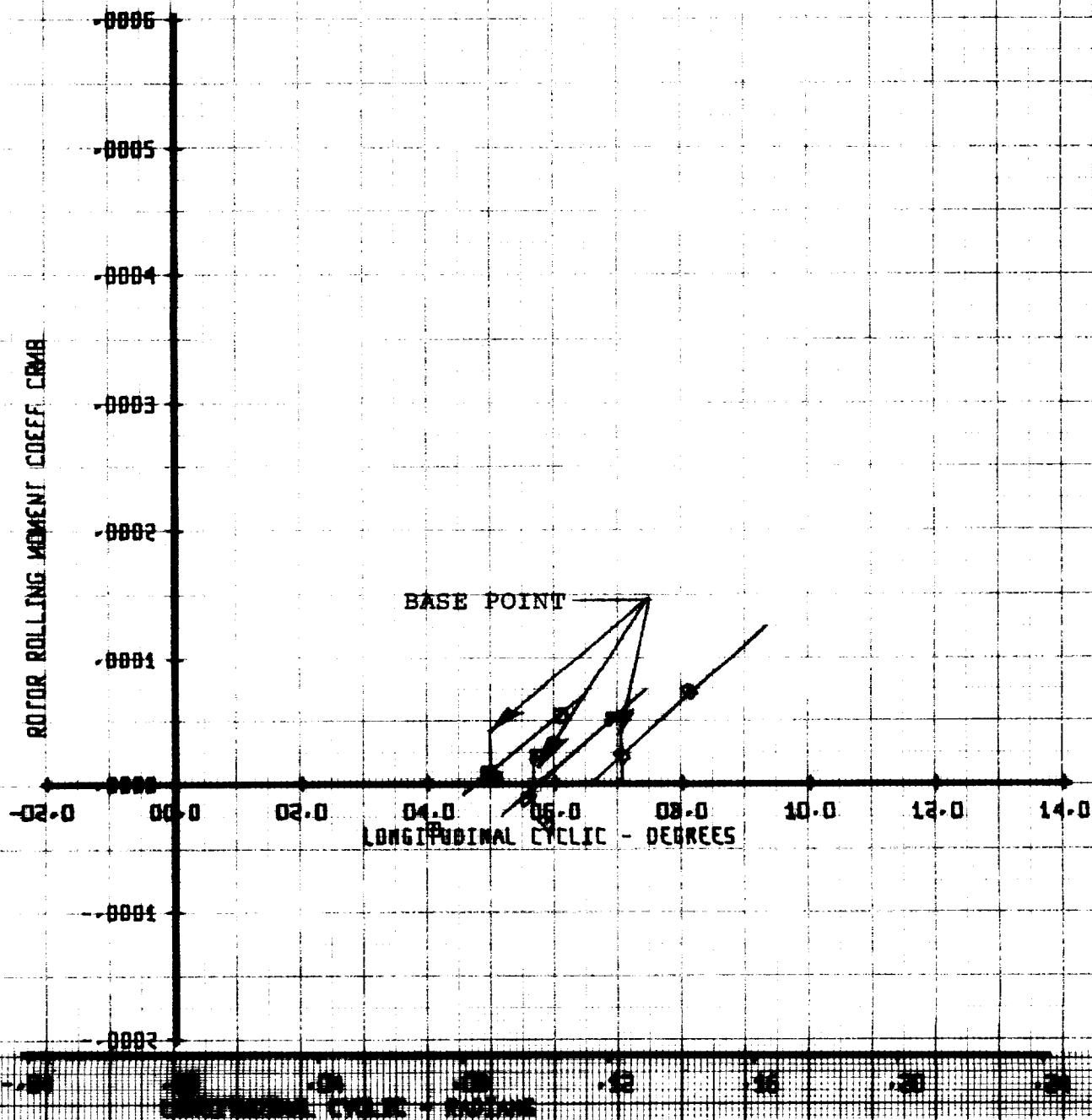


Figure C-115

LIFT-PROPUISIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

S/N	RUN	MU	X/CD2SB	CT'/SB	Y/TUN
32	32	.40	.01	.076	248
30	30	.40	.05	.076	248
33	33	.40	.10	.070	248

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

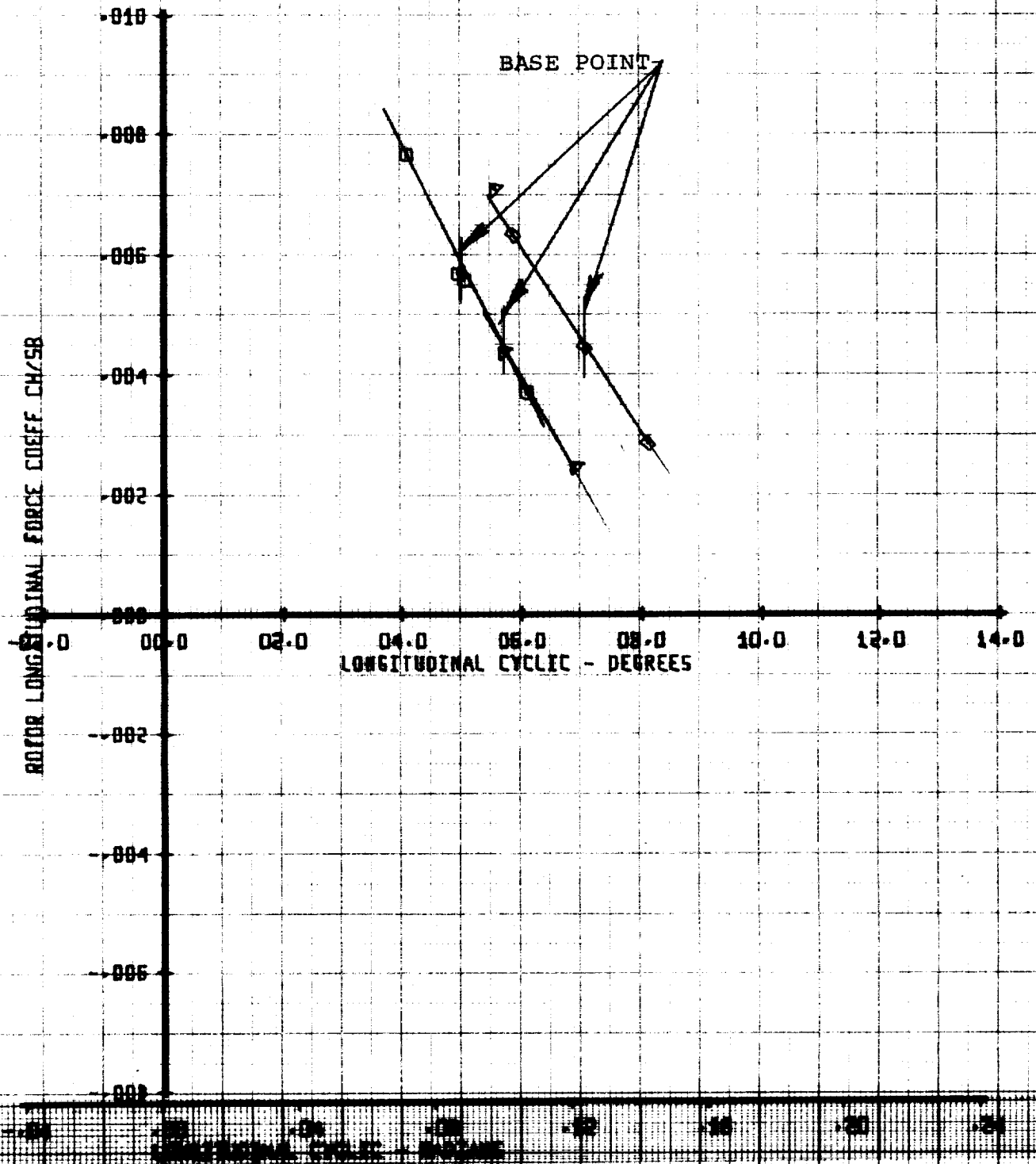


Figure C-116

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML'	X/DD2SB	CT'/SB	VTUN
□	32	.40	.01	.076	248
△	30	.40	.05	.076	248
◇	33	.40	.10	.070	248

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

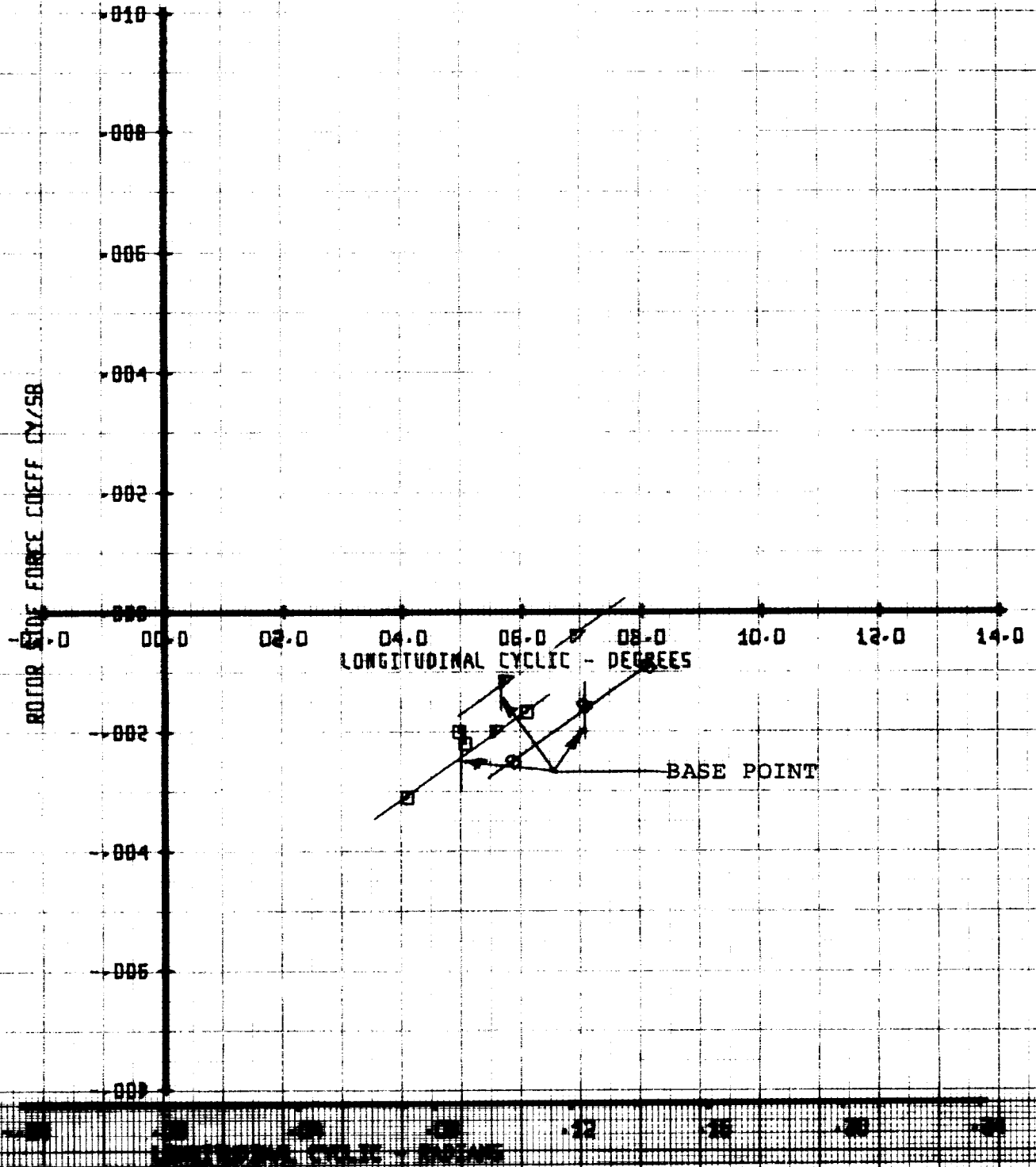


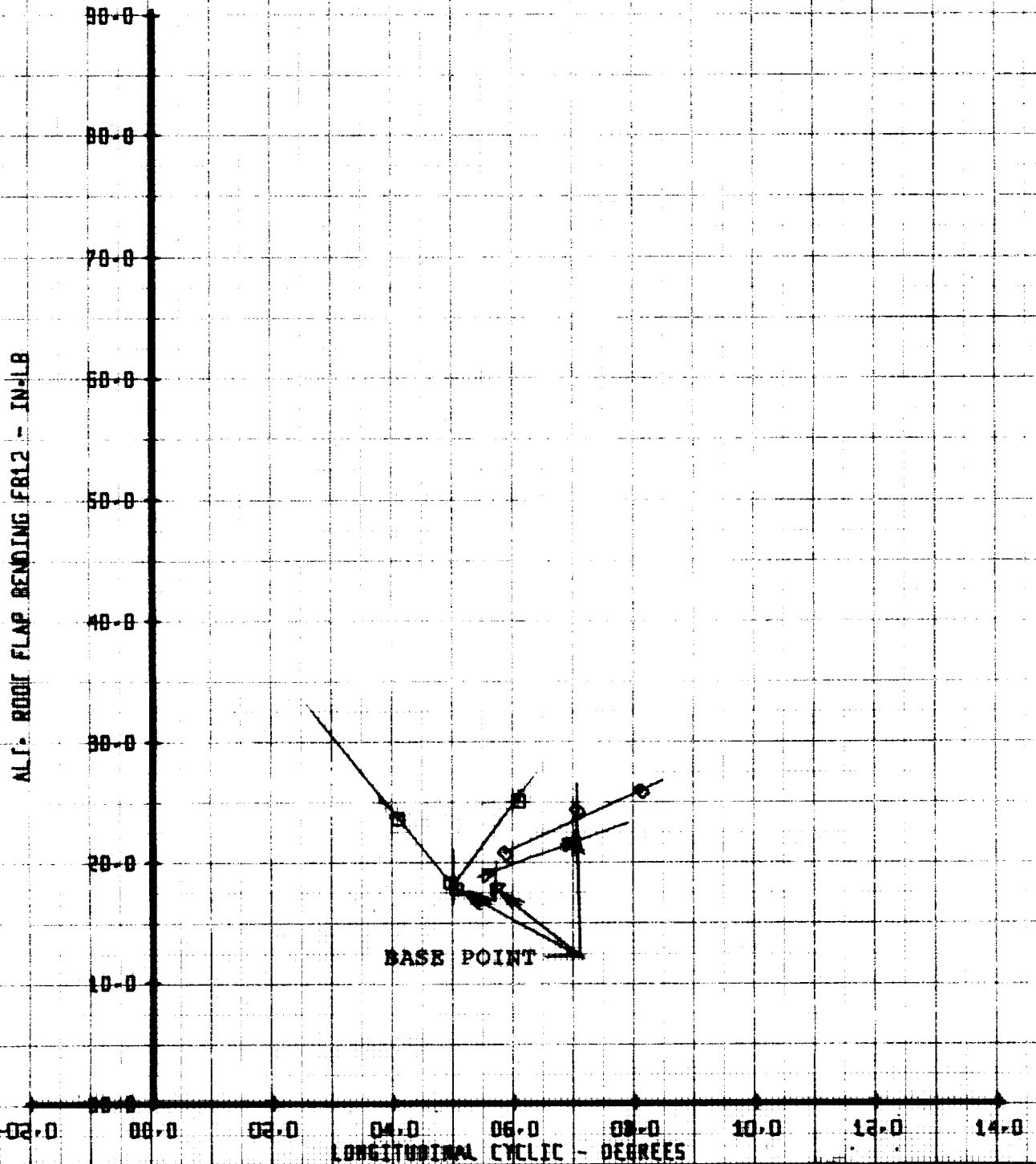
Figure C-117

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MJ'	X/00258	CT/98	VTUN
0	32	.40	.01	.076	248
1	30	.40	.05	.076	248
2	33	.40	.10	.070	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	ML' X/100258	CT' / 98	VTUN
□	32	.40	.01	.076
△	30	.40	.05	.076
◆	33	.40	.10	.070

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LONGITUDINAL CYCLIC

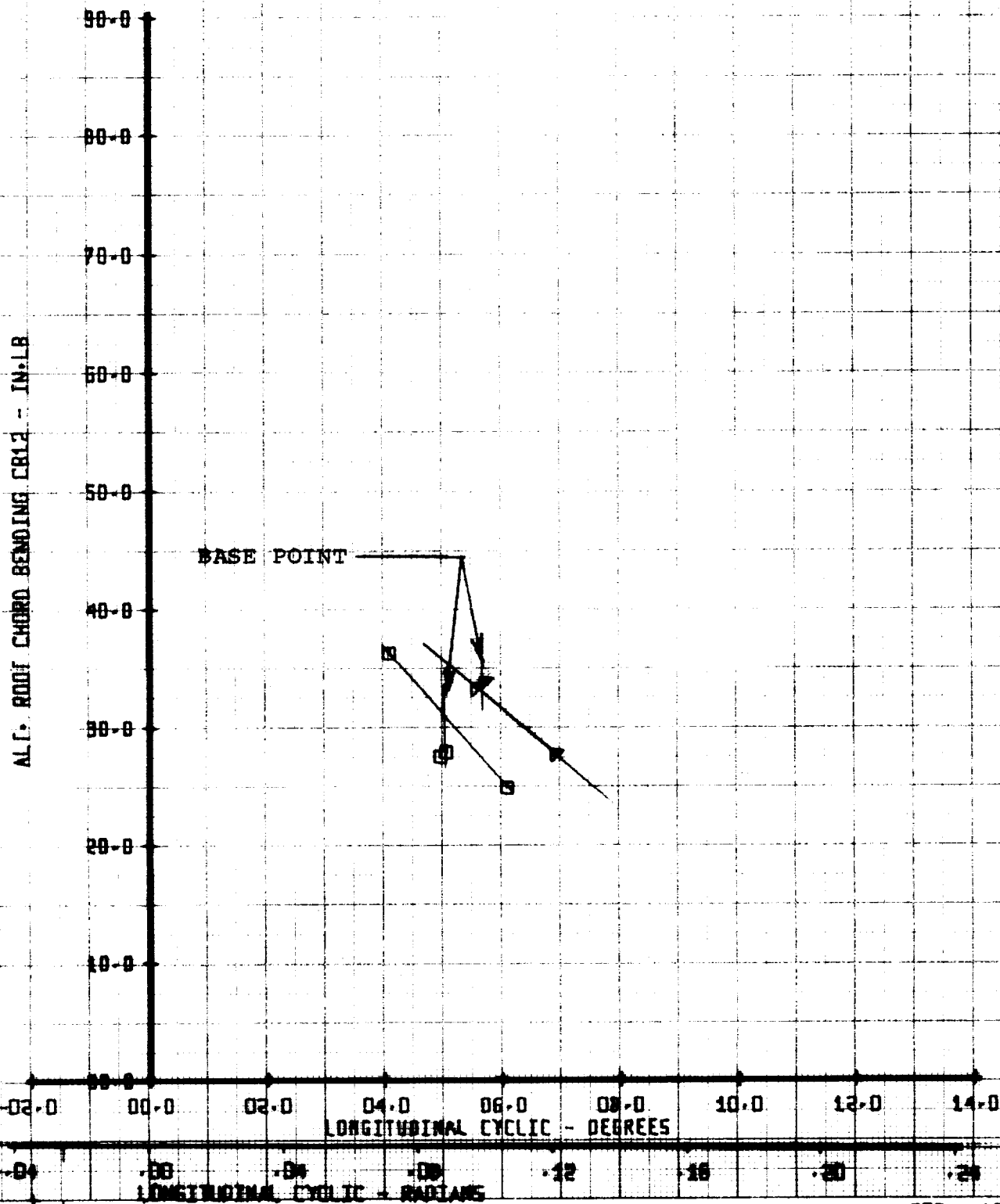


Figure C-119

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/98	VTUN
□	32	.40	.01	.076	248
△	30	.40	.05	.076	248
◇	33	.40	.10	.070	248

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC

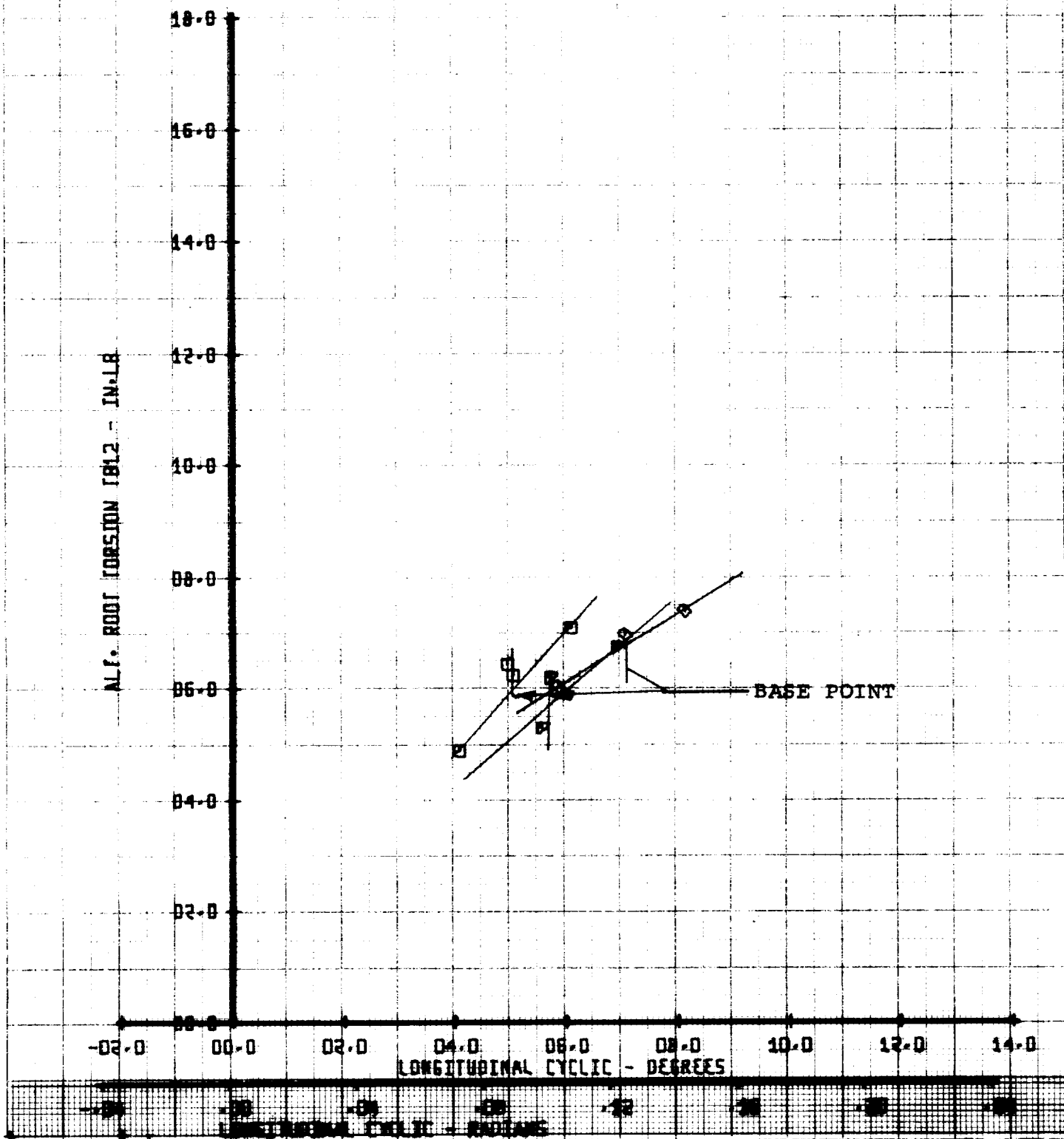


Figure C-120

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD258	CT'/98	VTUN
□	32	.40	.01	.100	248
△	32	.40	.01	.076	248

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

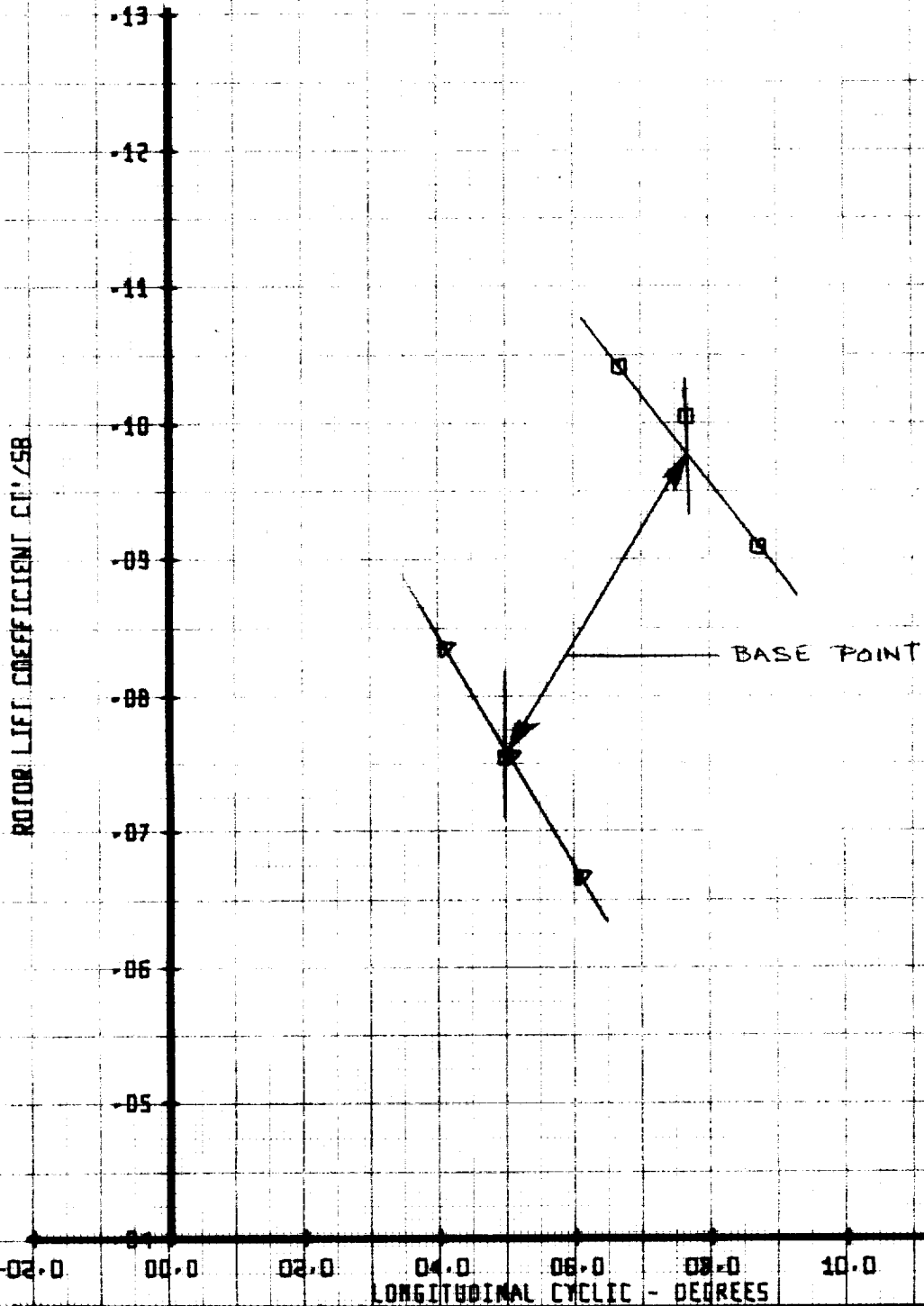


Figure C-121

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/58	VTUN
0	32	.40	.01	.100	248
7	32	.40	.01	.076	248

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

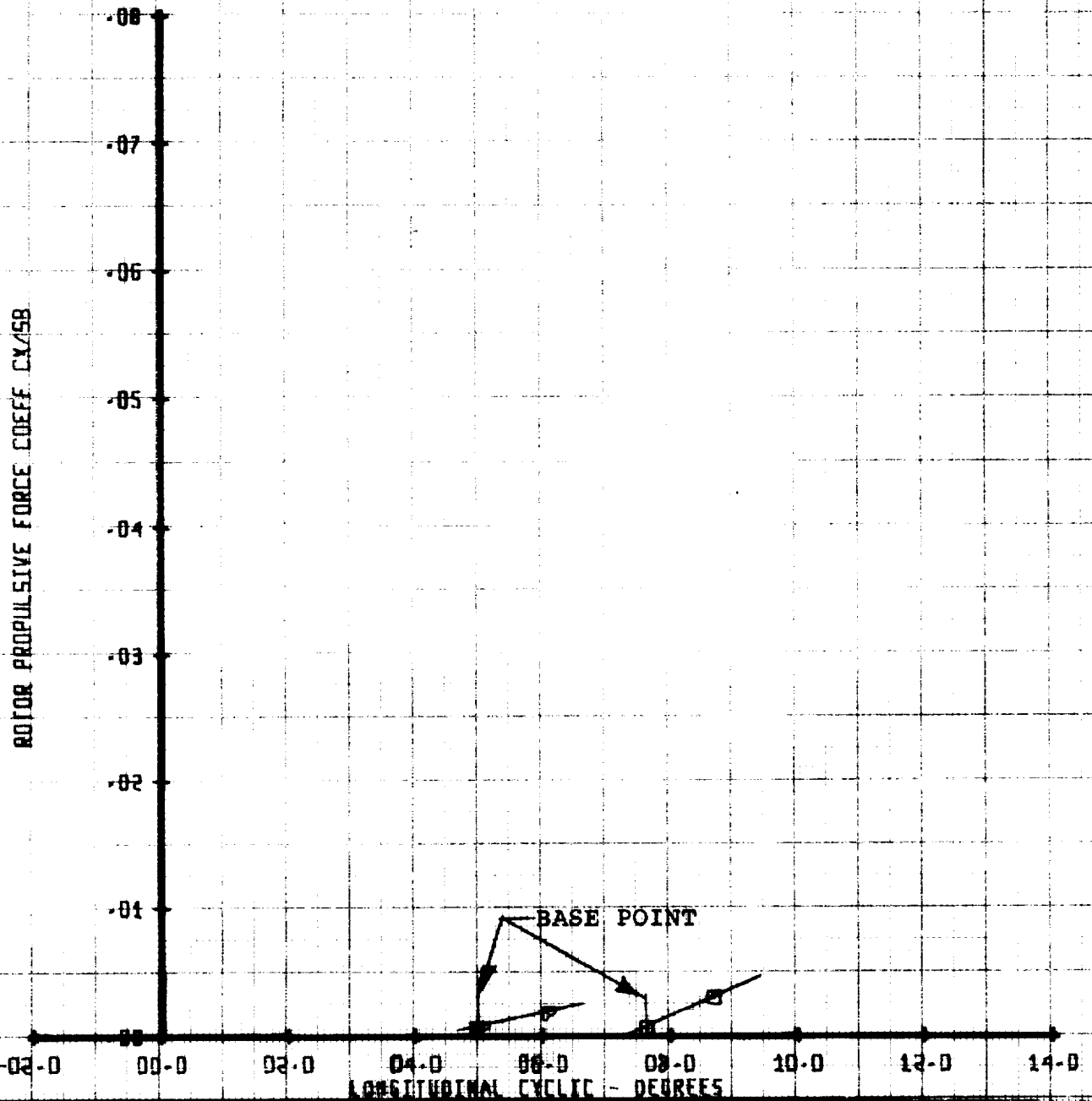


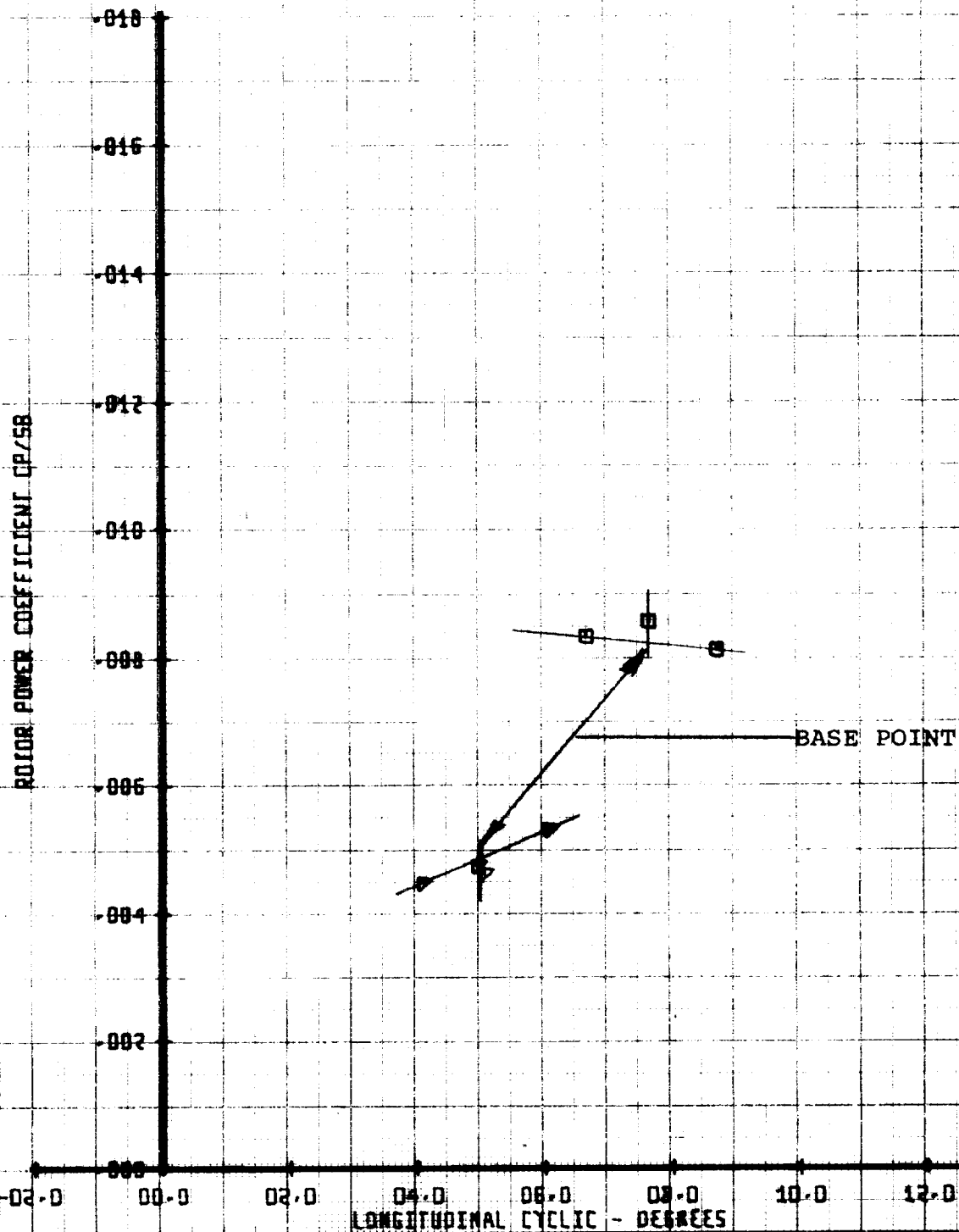
Figure C-122

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML'	X/DD25B	CT'/58	VTUN
□	32	.40	.01	.100	248
△	32	.40	.01	.076	248

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



LIFT-PROPUISIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU' X/00258	CT'/58	VTUN
Q	32	.40	.01	.100
P	32	.40	.01	.076

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

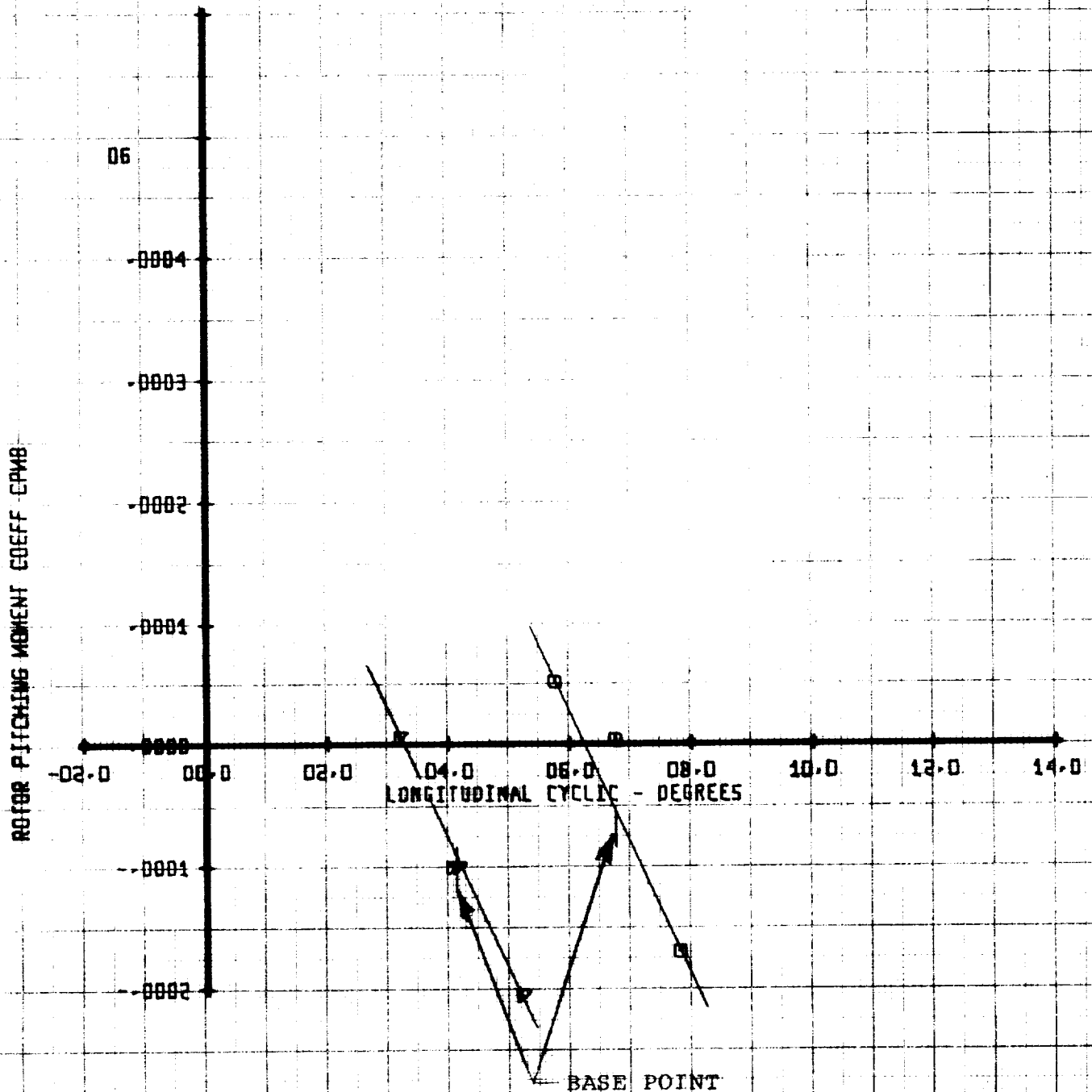


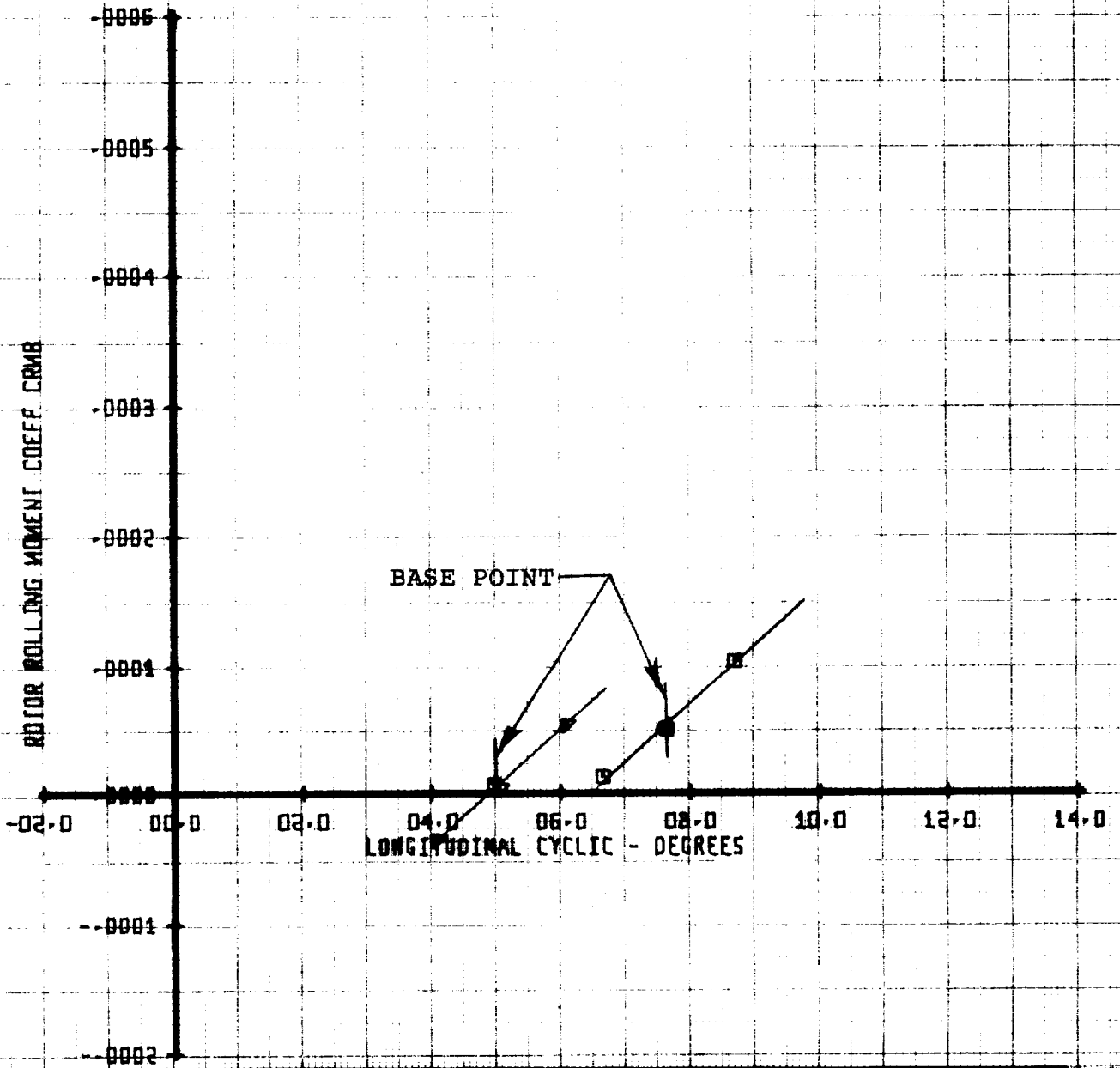
Figure C-124

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU' X/00258	CT'/98	VTUN
□	32	.40	.01	.100 248
▽	32	.40	.01	.076 248

ROTOR ROLLING MOMENT COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND					
SYM	RUN	MU	X/DD258	CT/98	YTUN
Q	32	.40	.01	.100	248
P	32	.40	.01	.076	248

Graph showing Rotor Longitudinal Force Coeff CH/SB (Y-axis) versus Longitudinal Cyclic - Degrees (X-axis).

The Y-axis ranges from 0.000 to 0.010. The X-axis ranges from 0.0 to 14.0 degrees.

Two data series are plotted, both showing a decreasing trend. A 'BASE POINT' is indicated at approximately (8.5, 0.009).

Longitudinal Cyclic - Degrees	Rotor Longitudinal Force Coeff CH/SB (Series 1)	Rotor Longitudinal Force Coeff CH/SB (Series 2)
4.0	0.0078	-
4.8	-	0.0058
5.0	0.0058	-
6.2	0.0038	-
6.8	-	0.0068
7.8	-	0.0052
8.5	-	0.0022

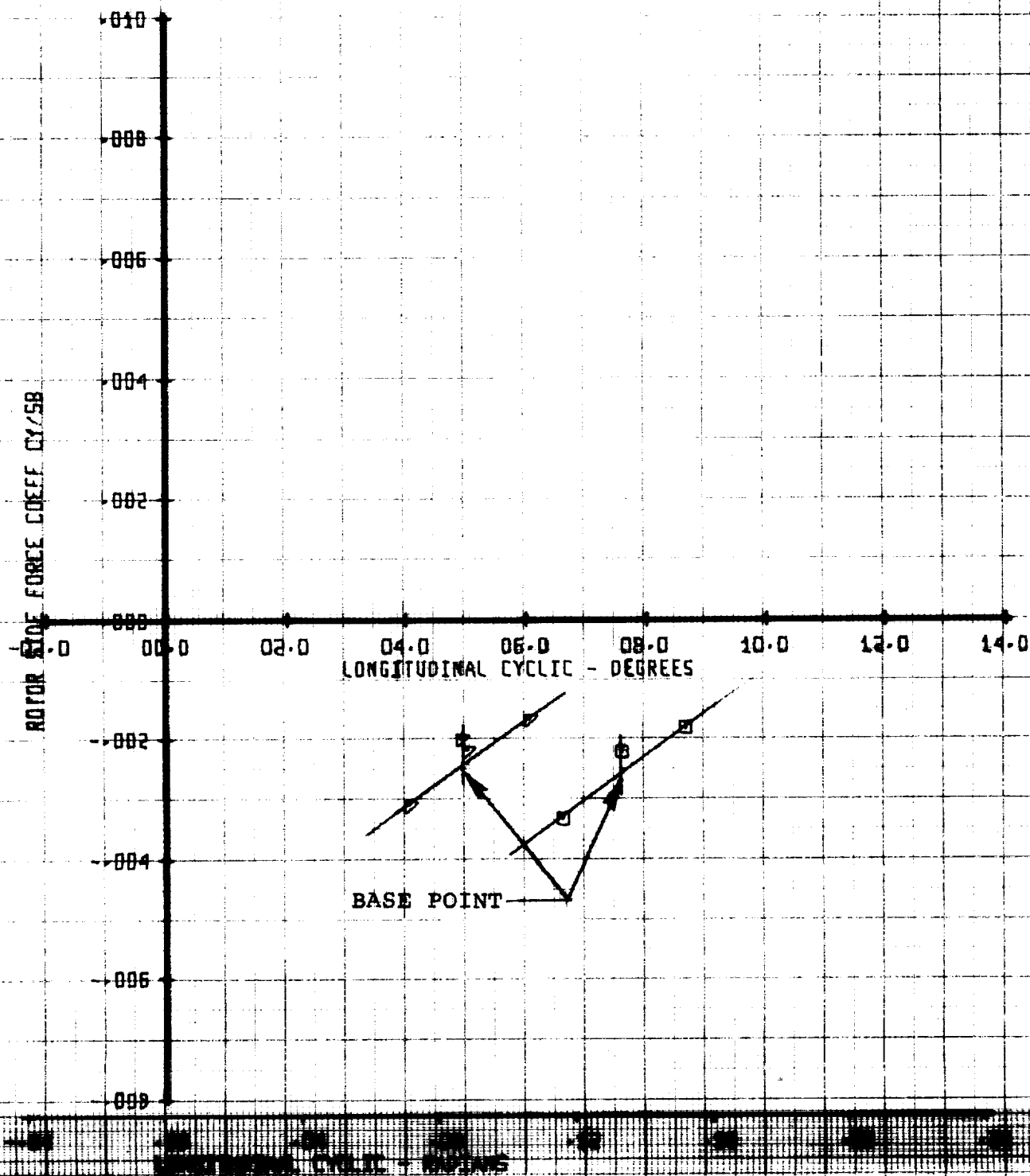
Figure C-126

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
0	32	.40	.01	.100	248
1	32	.40	.01	.076	248

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-42A ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/OD2SB	CT'/SB	VTUN
0	32	.40	.01	.100	248
1	32	.40	.01	.076	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC

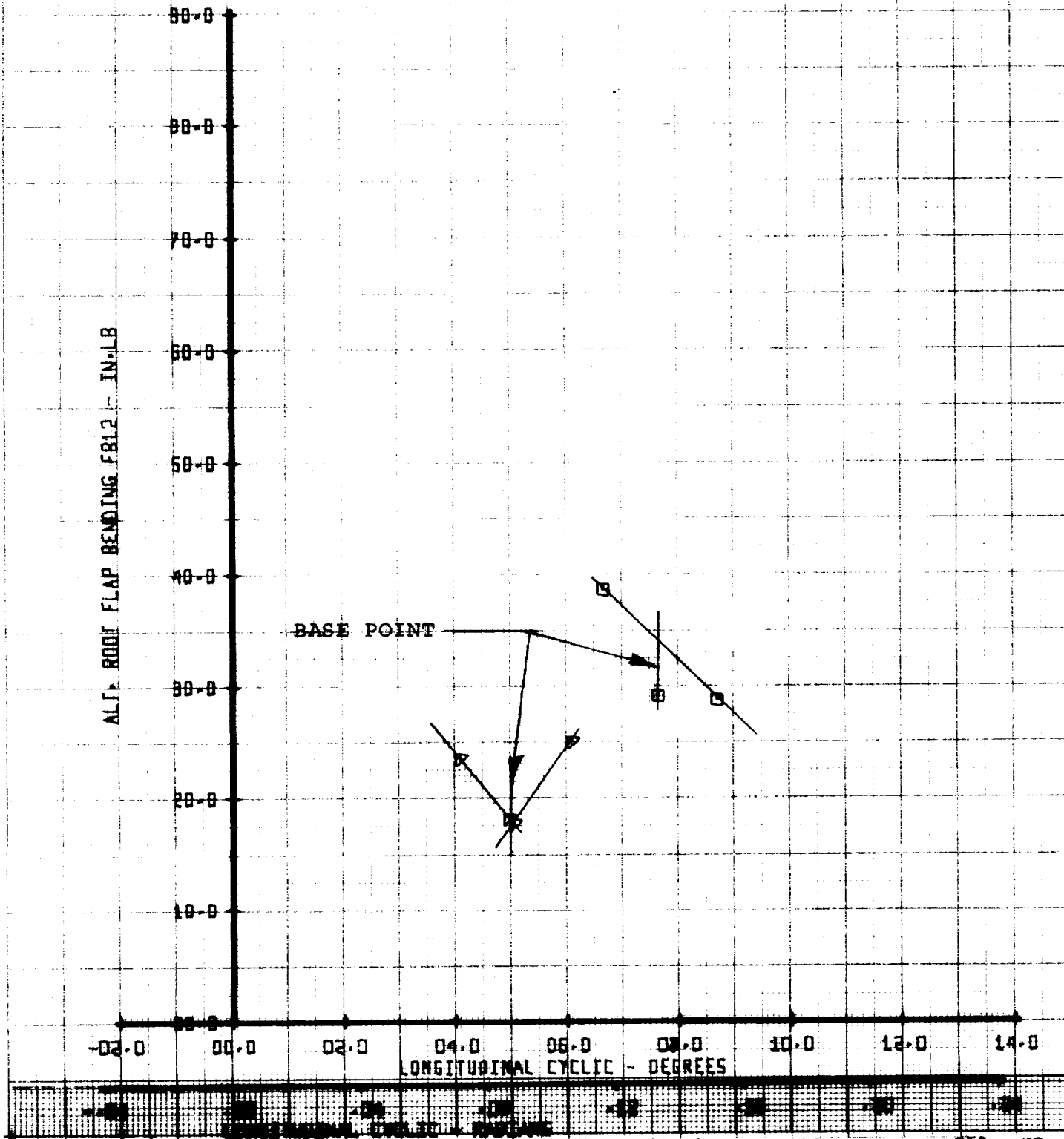


Figure C-128

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND					
SYM	RUN	MU'	X/00258	CT/98	VTUN
0	32	.40	.01	.100	248
Δ	32	.40	.01	.076	248

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LONGITUDINAL CYCLIC

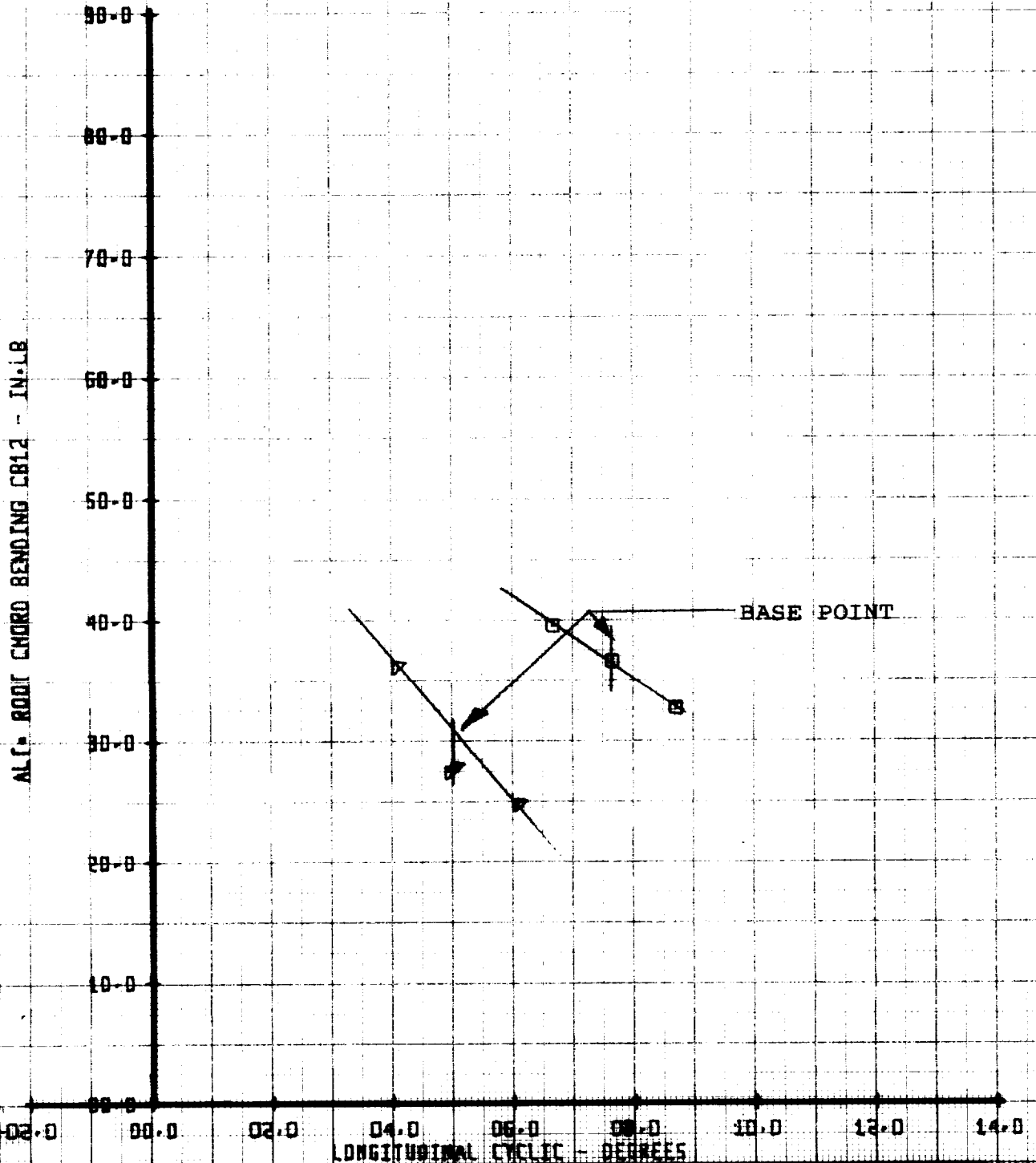


Figure C-129

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CI/58	VTUN
□	32	.40	.01	.100	24B
▽	32	.40	.01	.076	24B

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC

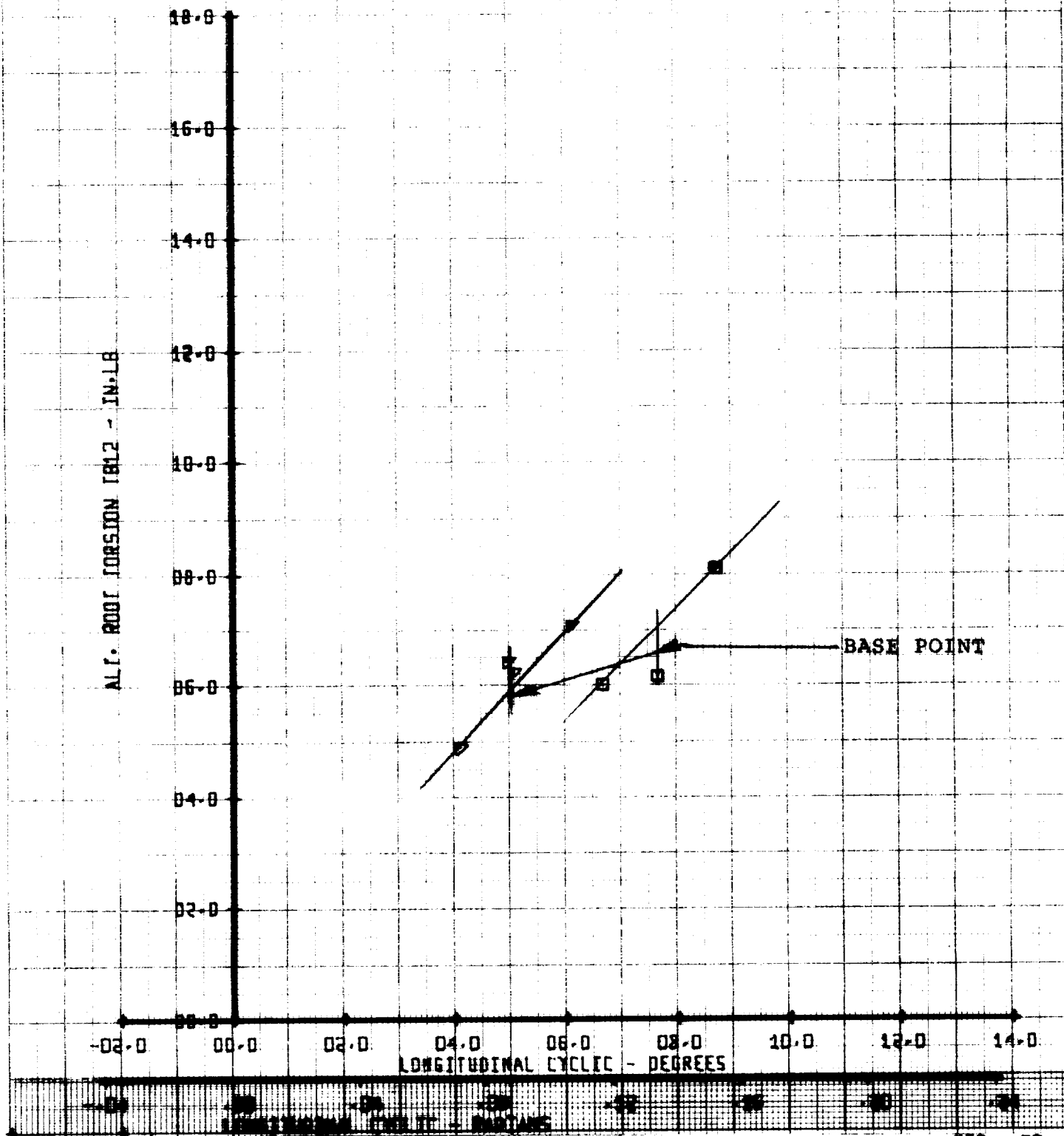


Figure C-130

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/58	VTUN
□	33	.40	.10	.088	248
△	33	.40	.10	.070	248

ROTOR LIFT COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

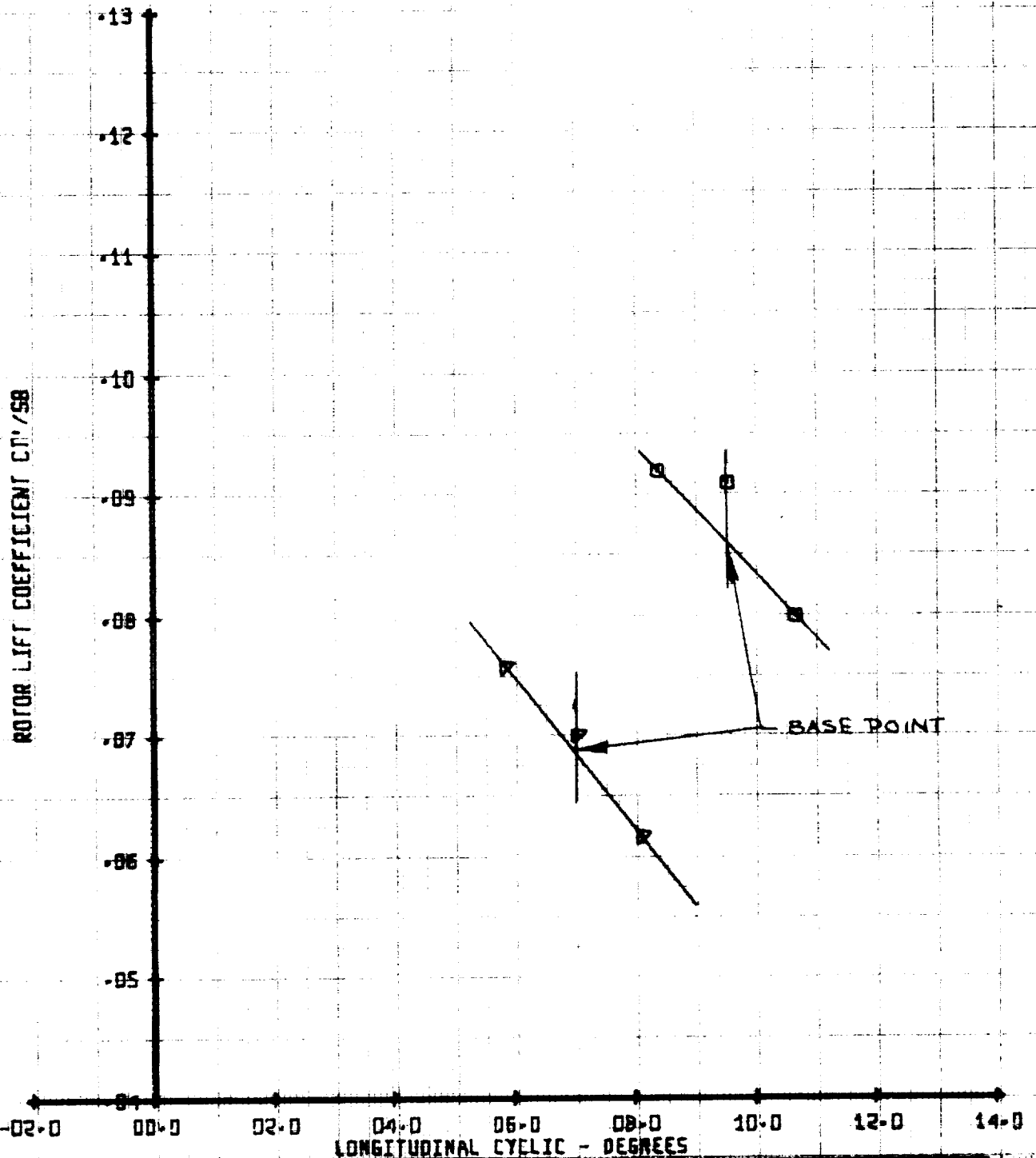


Figure C-131

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT ² /SB	VTUN
□	33	.40	.10	.088	248
▽	33	.40	.10	.070	248

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

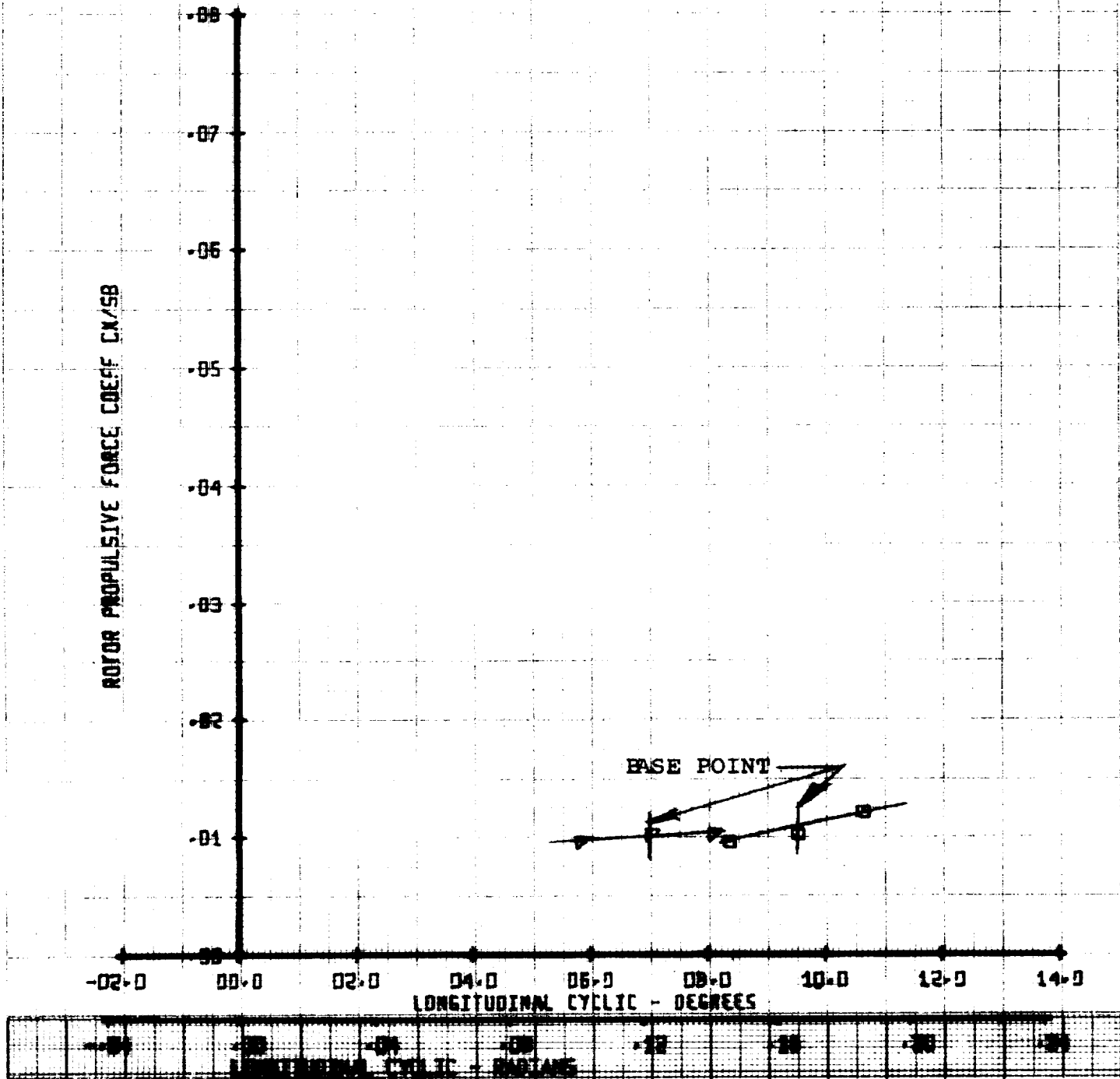


Figure C-132

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
□	33	.40	.10	.088	248
△	33	.40	.10	.070	248

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

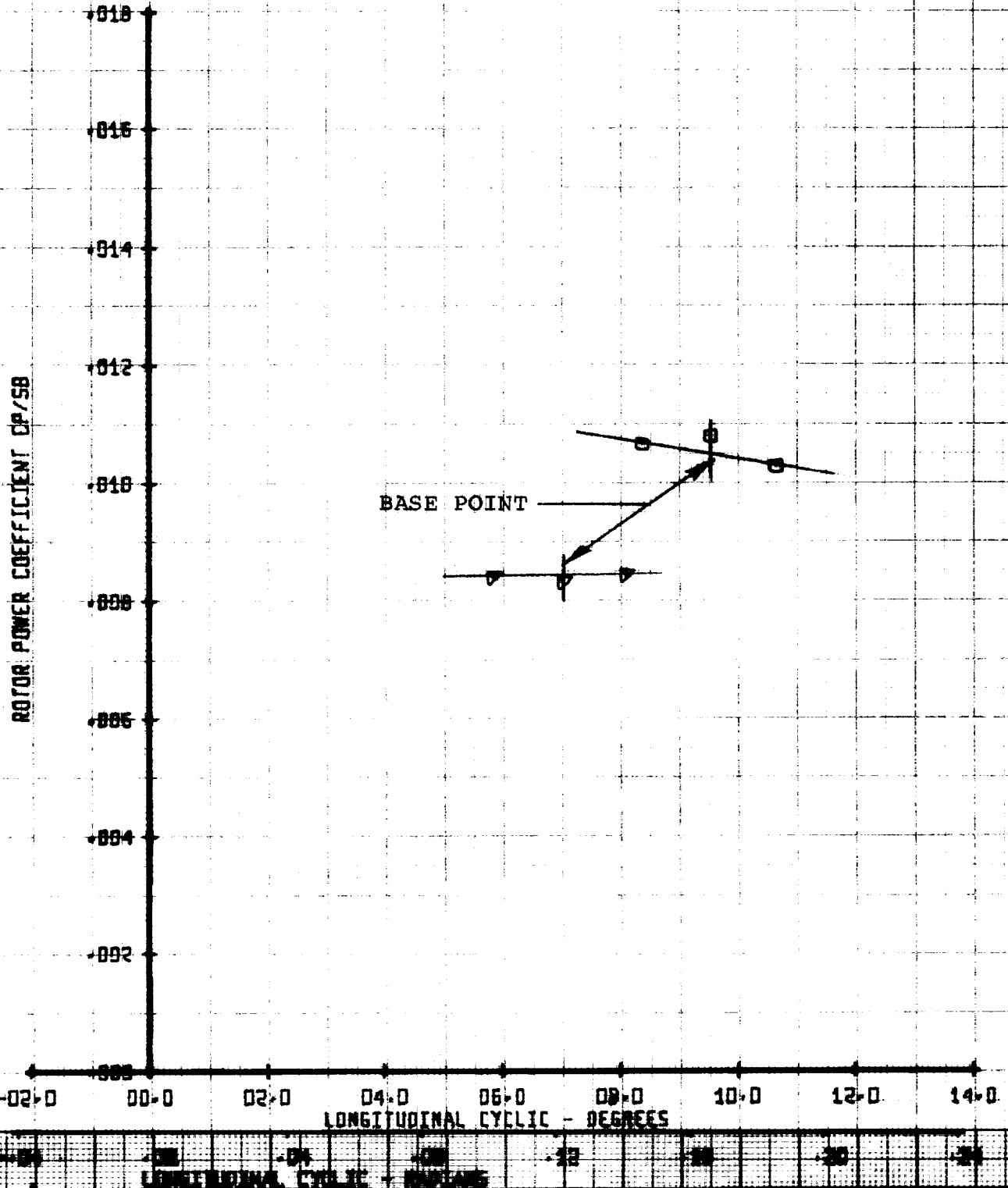


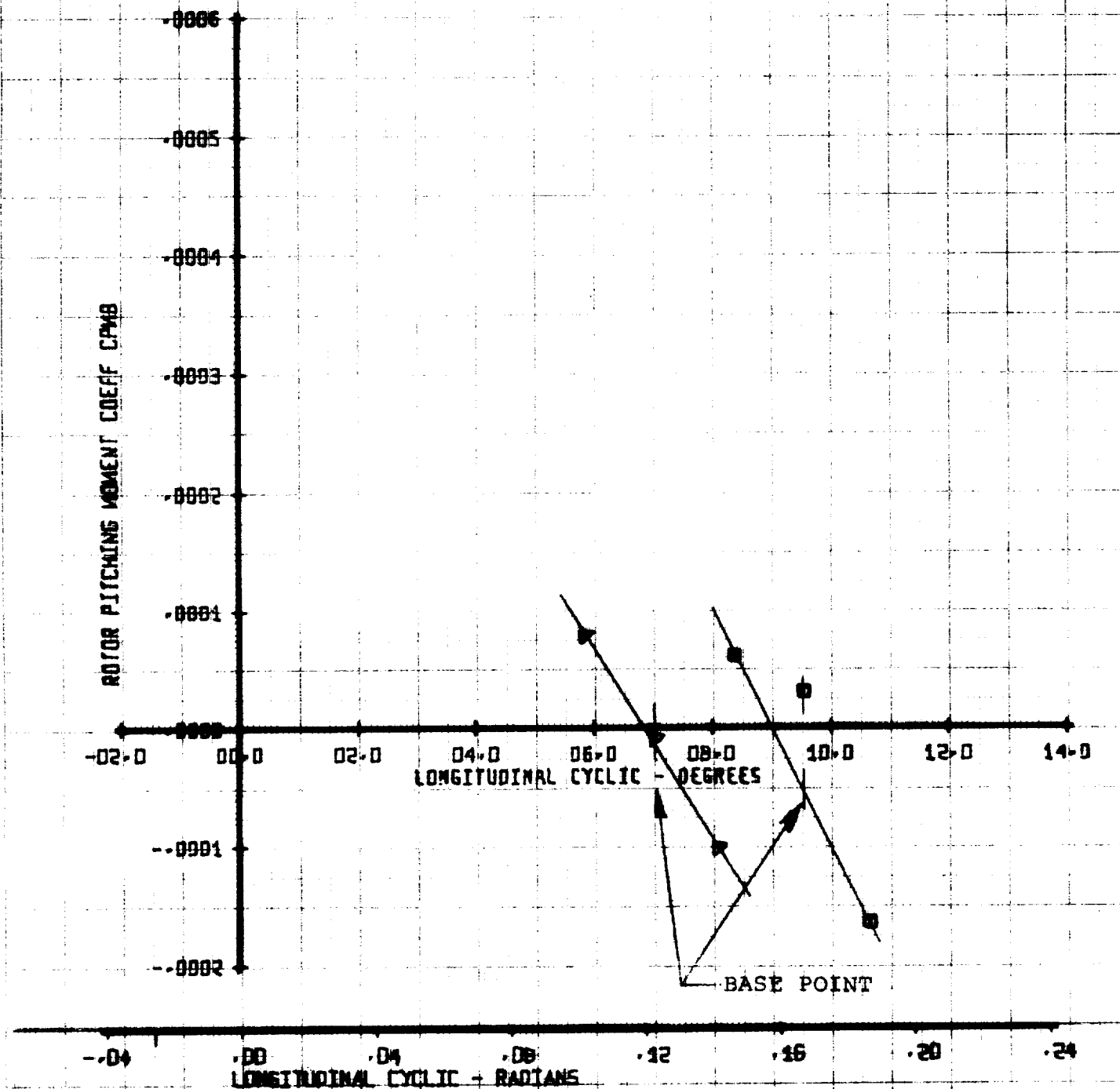
Figure C-133

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT*/58	VTUN
□	33	.40	.10	.088	24B
○	33	.40	.10	.070	24B

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MJ	X/0025B	CT'5B	VTUN
0	33	.40	.10	.099	24B
1	33	.40	.10	.070	24B

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

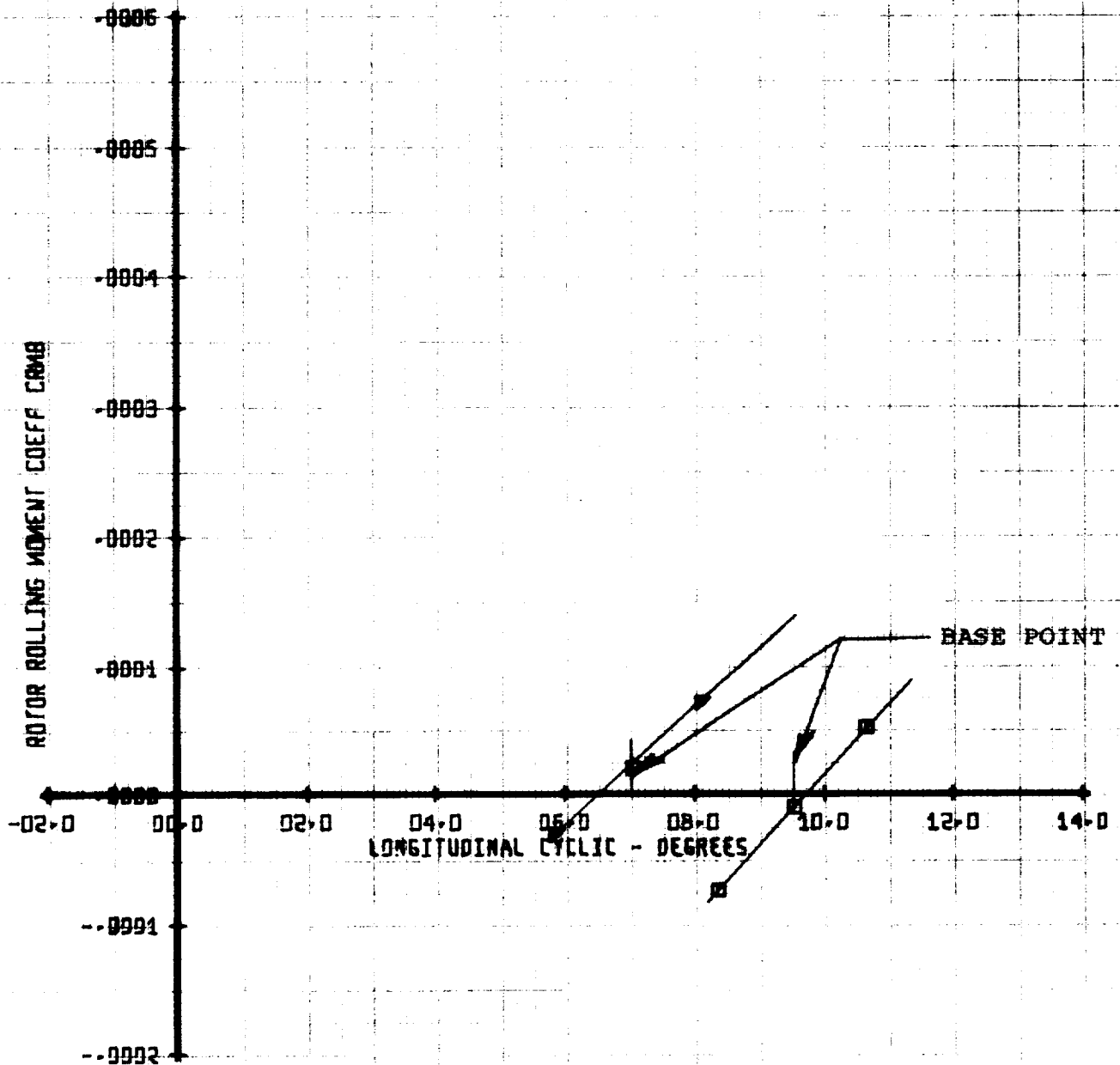


Figure C-135

LEFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MJ	X/00258	CT/58	WTUN
0	33	.40	.10	.088	248
Δ	33	.40	.10	.070	248

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

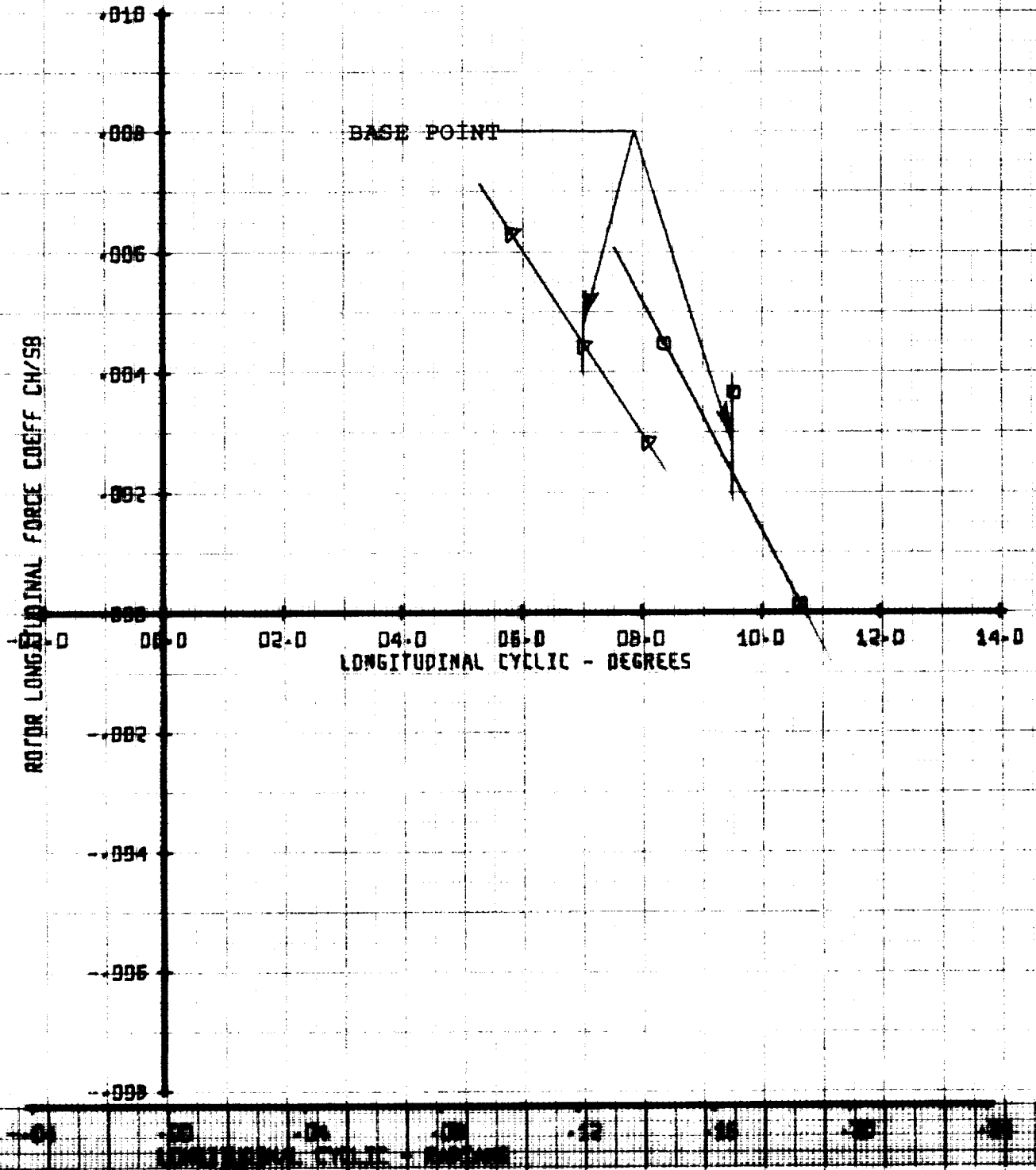


Figure C-136

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
0	33	.40	.10	.088	248
7	33	.40	.10	.070	248

ROTOR SIDE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

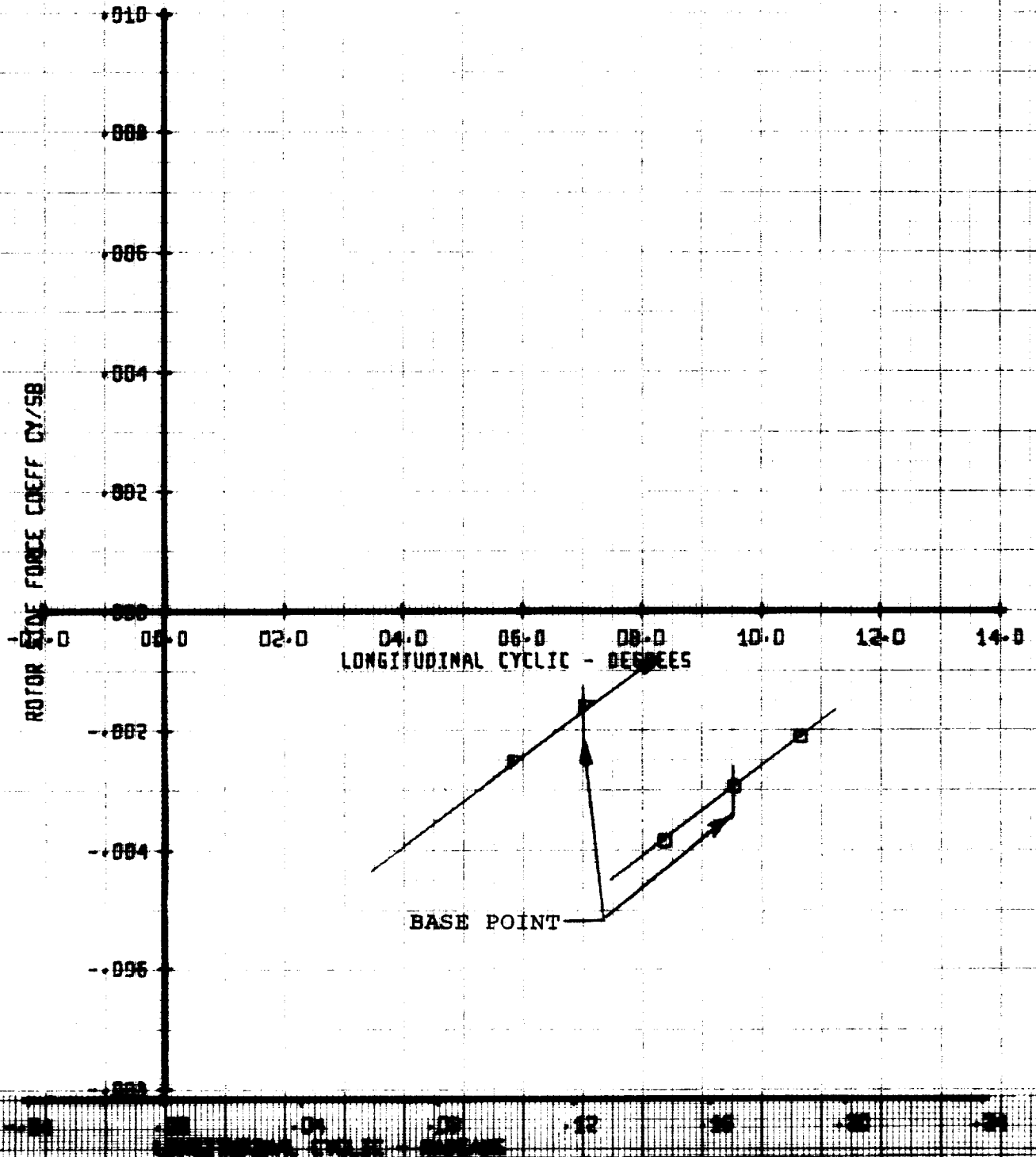


Figure C-137

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD258	CT/58	VTUN
33	33	.40	.10	.088	248
33	33	.40	.10	.070	248

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC

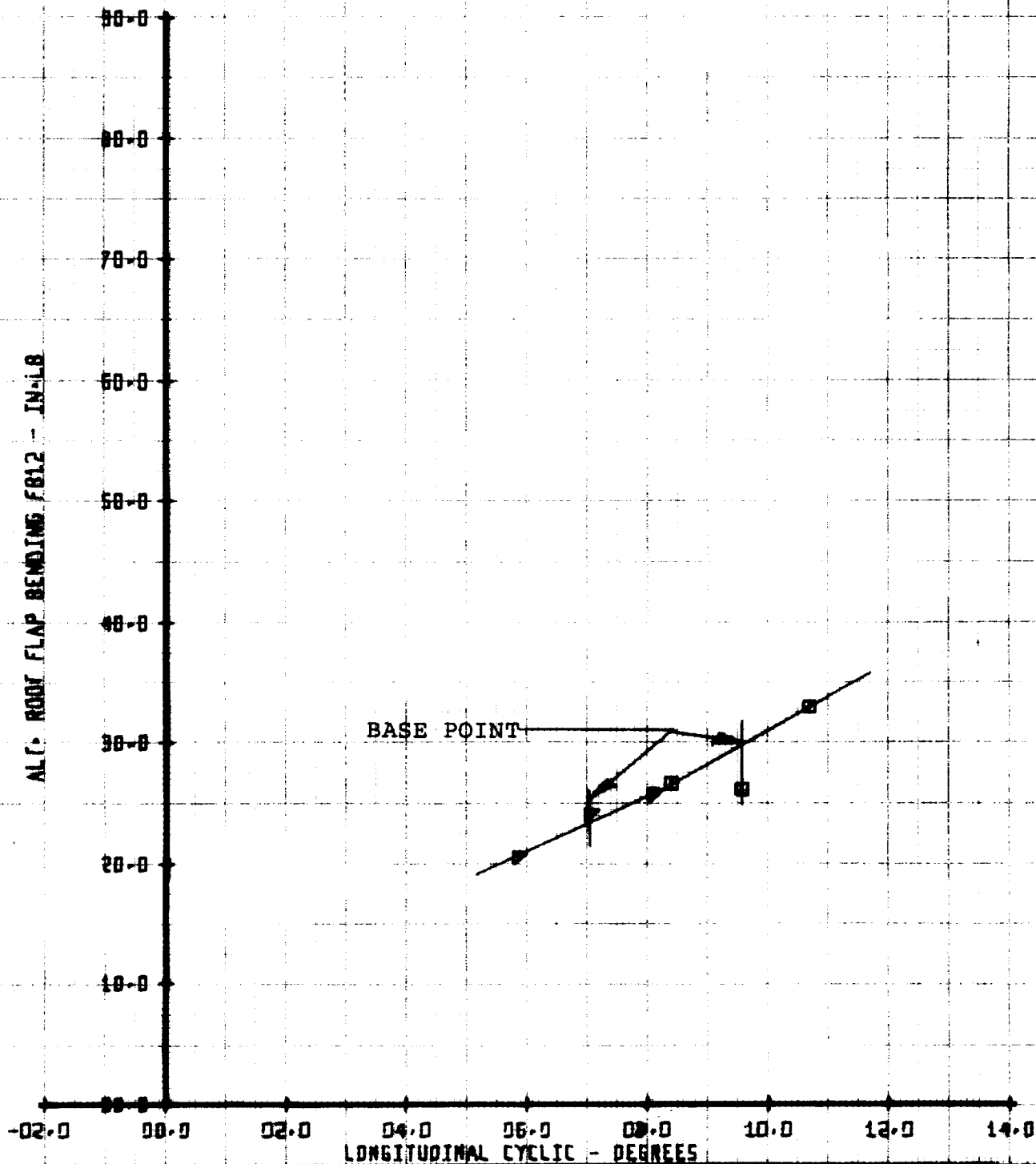


Figure C-138

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD258	CT/58	YTUN
□	33	.40	.10	.099	248
△	33	.40	.10	.070	248

ALTERNATING ROOT TORSION TB12
 VERSUS
 LONGITUDINAL CYCLIC

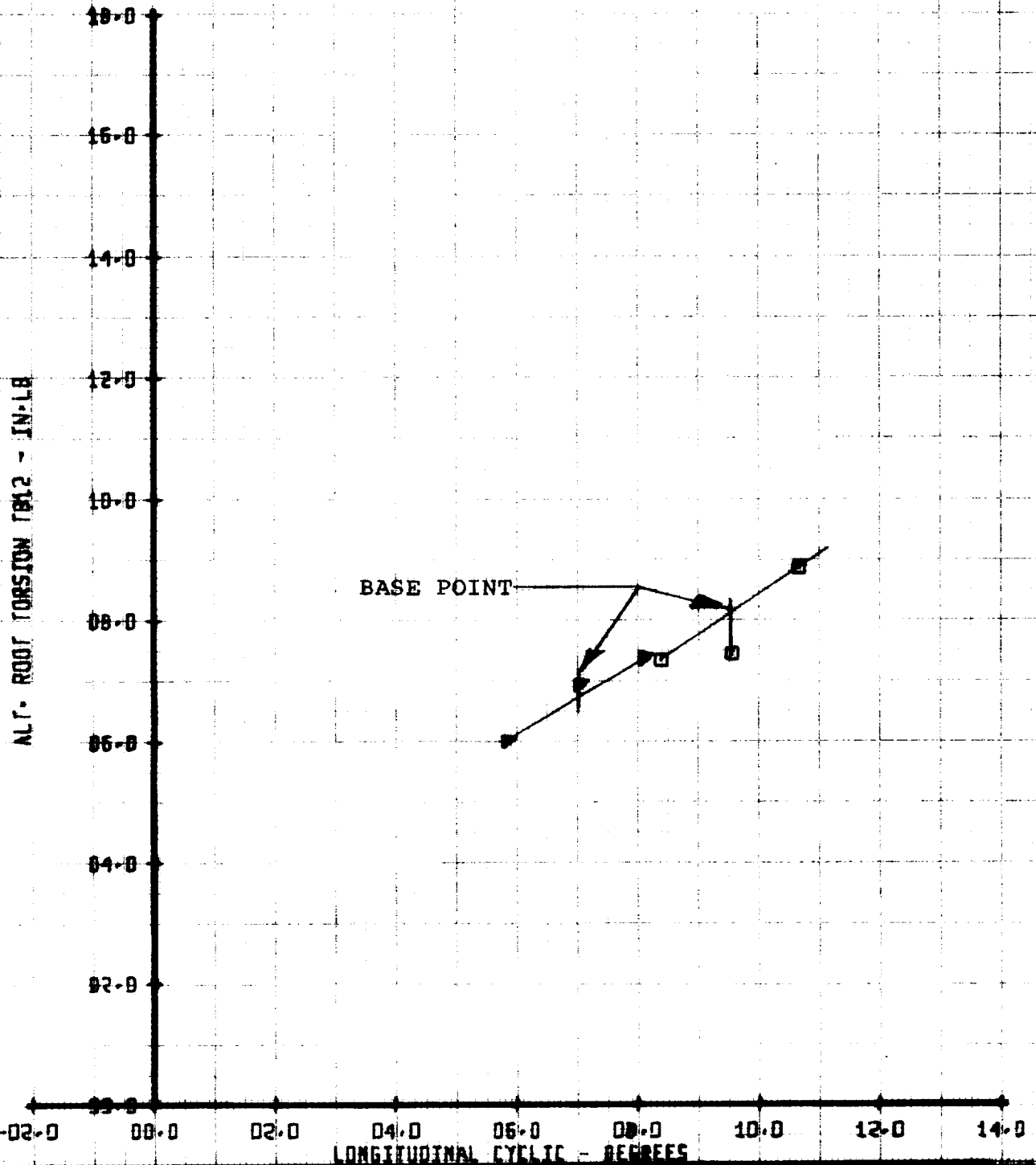


Figure C-139

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/002SB	CT'/SB	VTUN
□	39	.50	.05	.098	310
△	41	.50	.10	.090	310
◇	42	.50	.20	.073	310

ROTOR LIFT COEFFICIENT
 VERSUS
 LATERAL CYCLIC

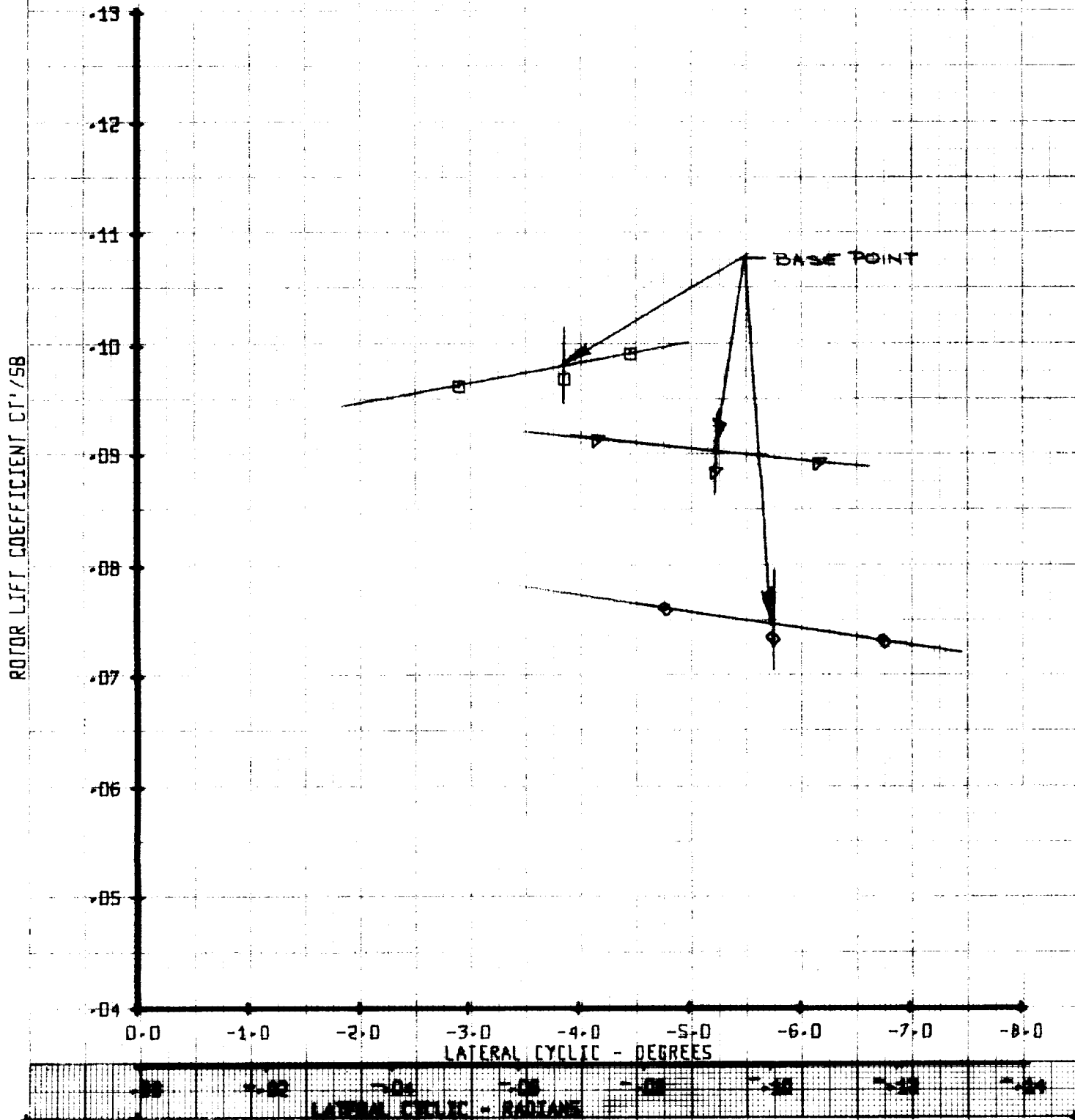


Figure C-140

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/0025B	CT'/5B	VTUN
□	39	.50	.05	.098	310
▽	41	.50	.10	.090	310
◇	42	.50	.20	.073	318

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

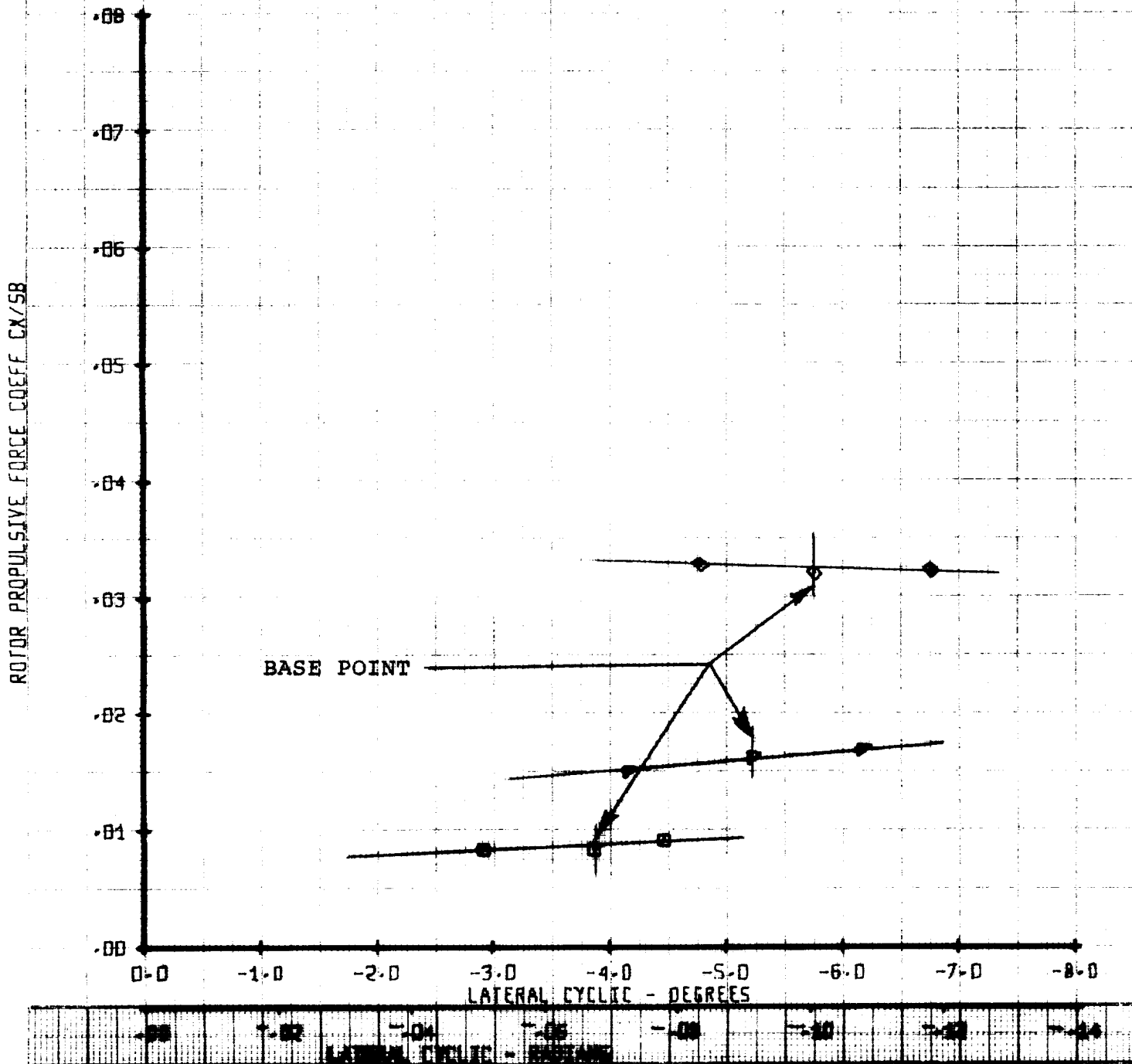


Figure C-141

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD25B	CT'/SB	VTUN
□	39	.50	.05	.098	310
▽	41	.50	.10	.090	310
◇	42	.50	.20	.073	310

ROTOR POWER COEFFICIENT
 VERSUS
 LATERAL CYCLIC

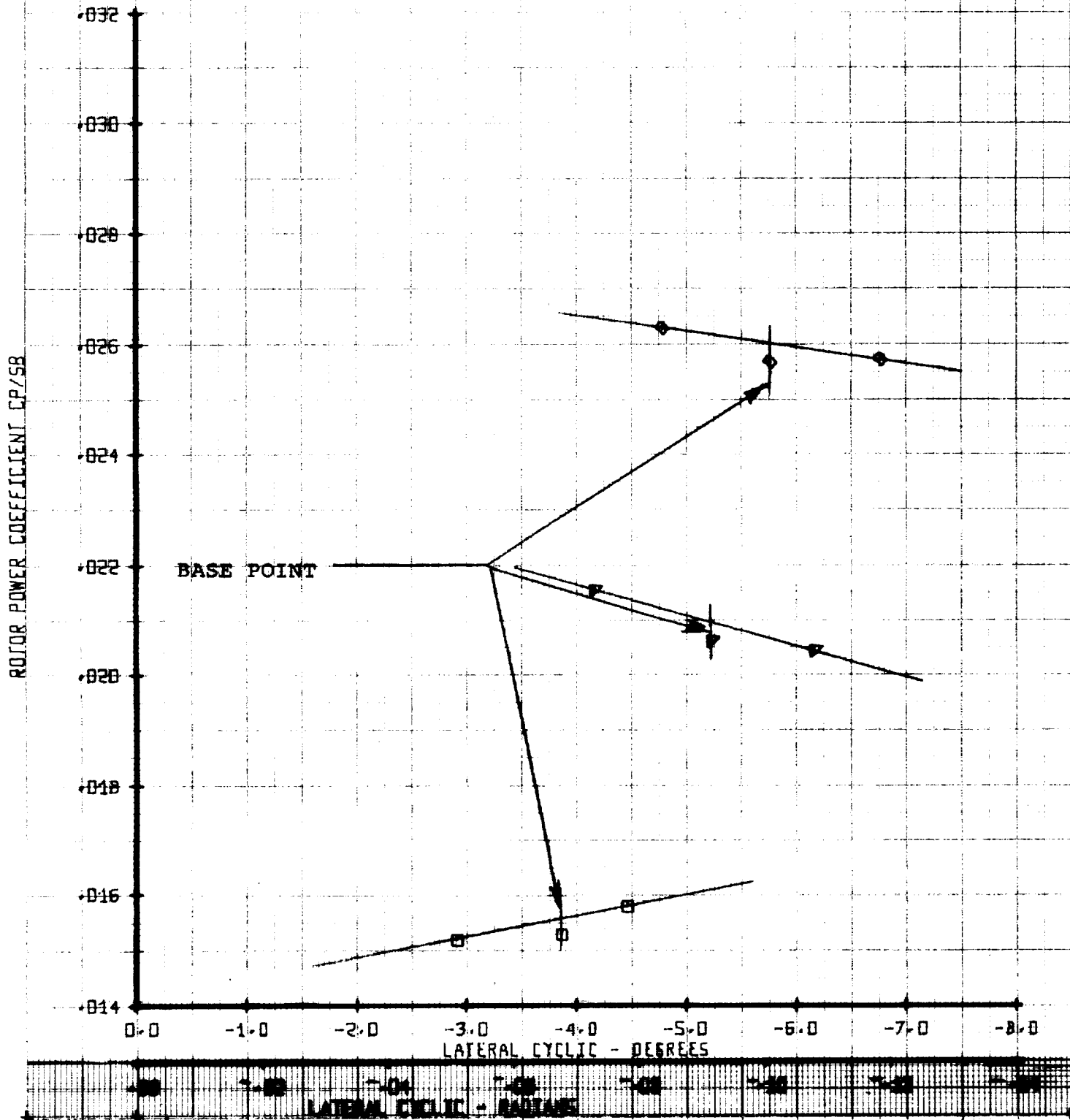


Figure C-142

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/258	VTUN
□	39	.50	.05	.098	310
△	41	.50	.10	.090	310
◇	42	.50	.20	.073	310

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

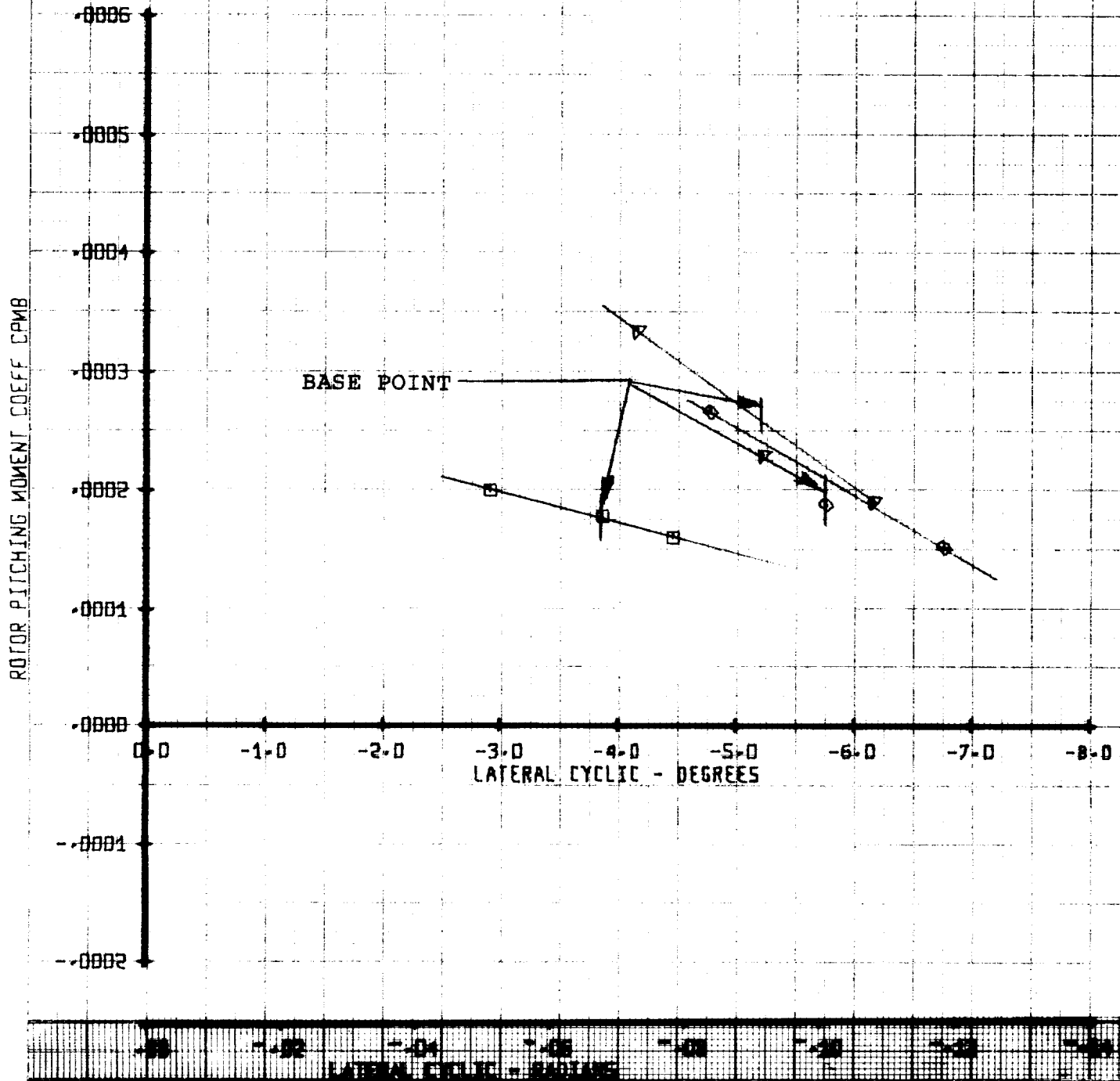


Figure C-143

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/58	VTUN
□	39	.50	.05	.098	310
▽	41	.50	.10	.090	310
◇	42	.50	.20	.073	310

ROTOR ROLLING MOMENT COEFFICIENT
 VERSUS
 LATERAL CYCLIC

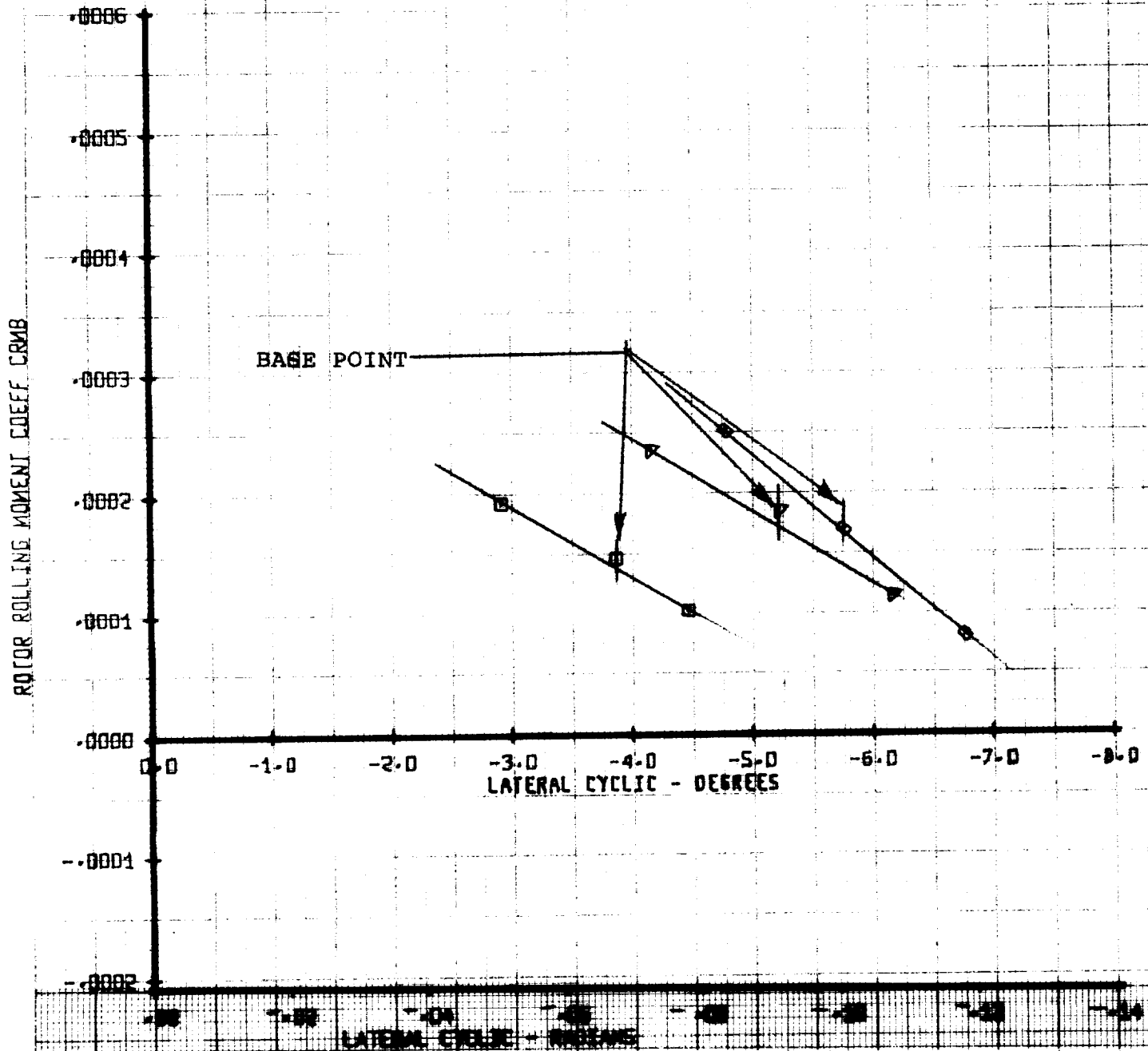


Figure C-144

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT'/SB	VTUN
□	39	.50	.05	.098	310
△	41	.50	.10	.090	310
◇	42	.50	.20	.073	310

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

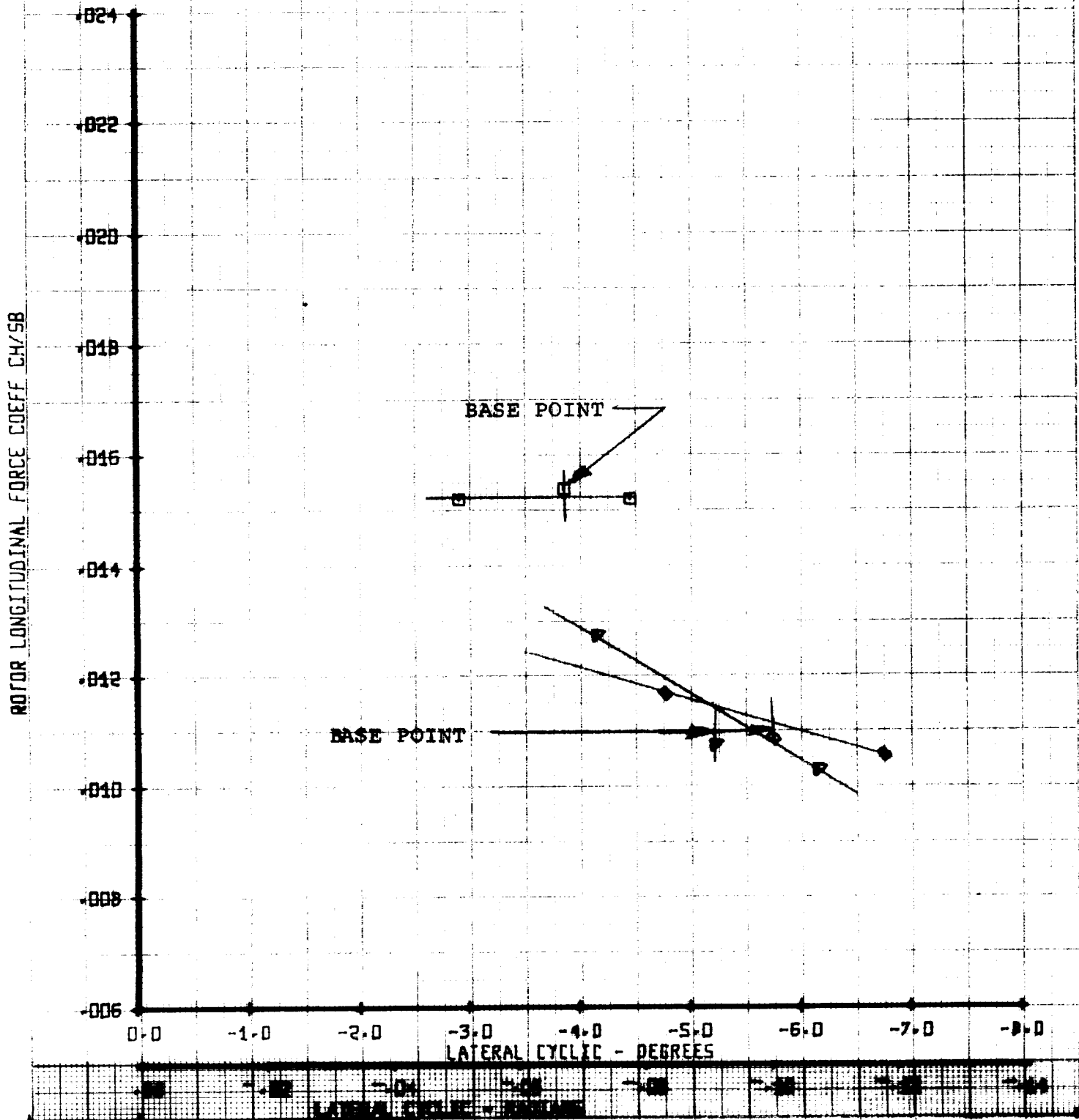


Figure C-145

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CI/58	VIUN
□	39	.50	.05	.098	310
▽	41	.50	.10	.090	310
◇	42	.50	.20	.073	310

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

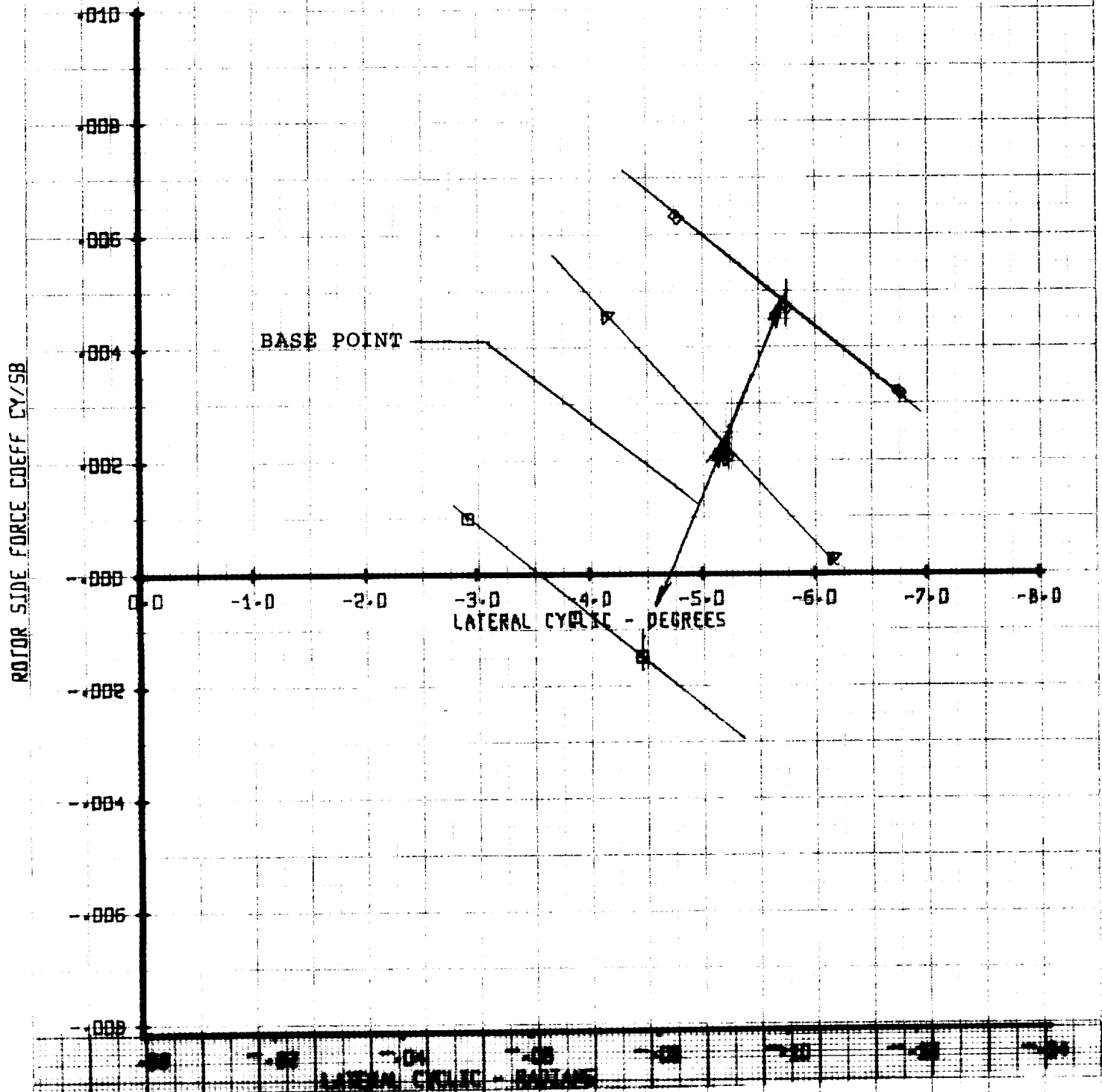


Figure C-146

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	ET/58	VTUN
□	39	.50	.05	.098	310
▴	41	.50	.10	.090	310
◇	42	.50	.20	.073	310

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

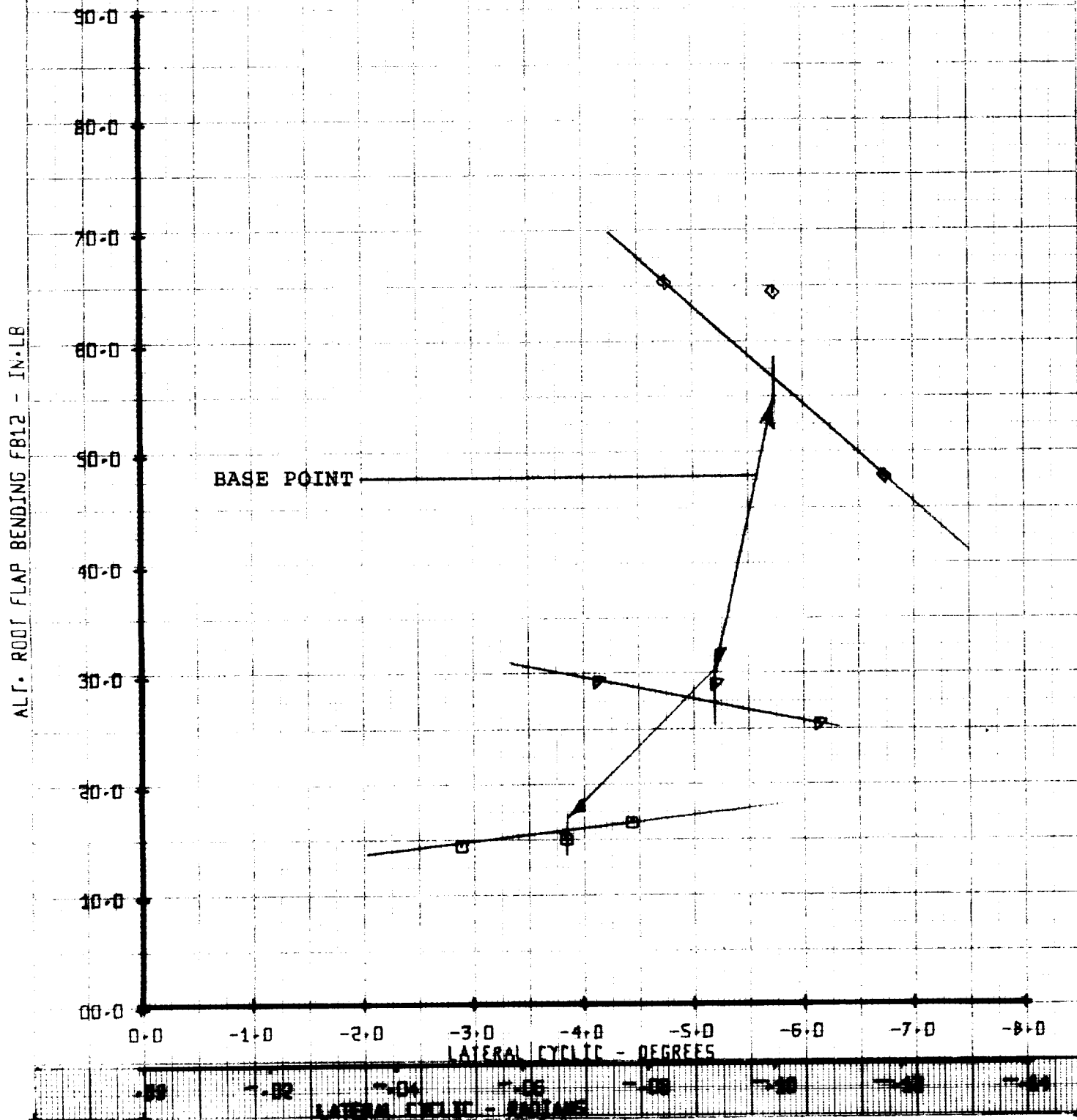


Figure C-147

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD2SB	CT/5B	VTUN
□	39	.50	.05	.098	310
△	41	.50	.10	.090	310
◇	42	.50	.20	.073	310

ALTERNATING ROOT TORSION TB12
VERSUS
LATERAL CYCLIC

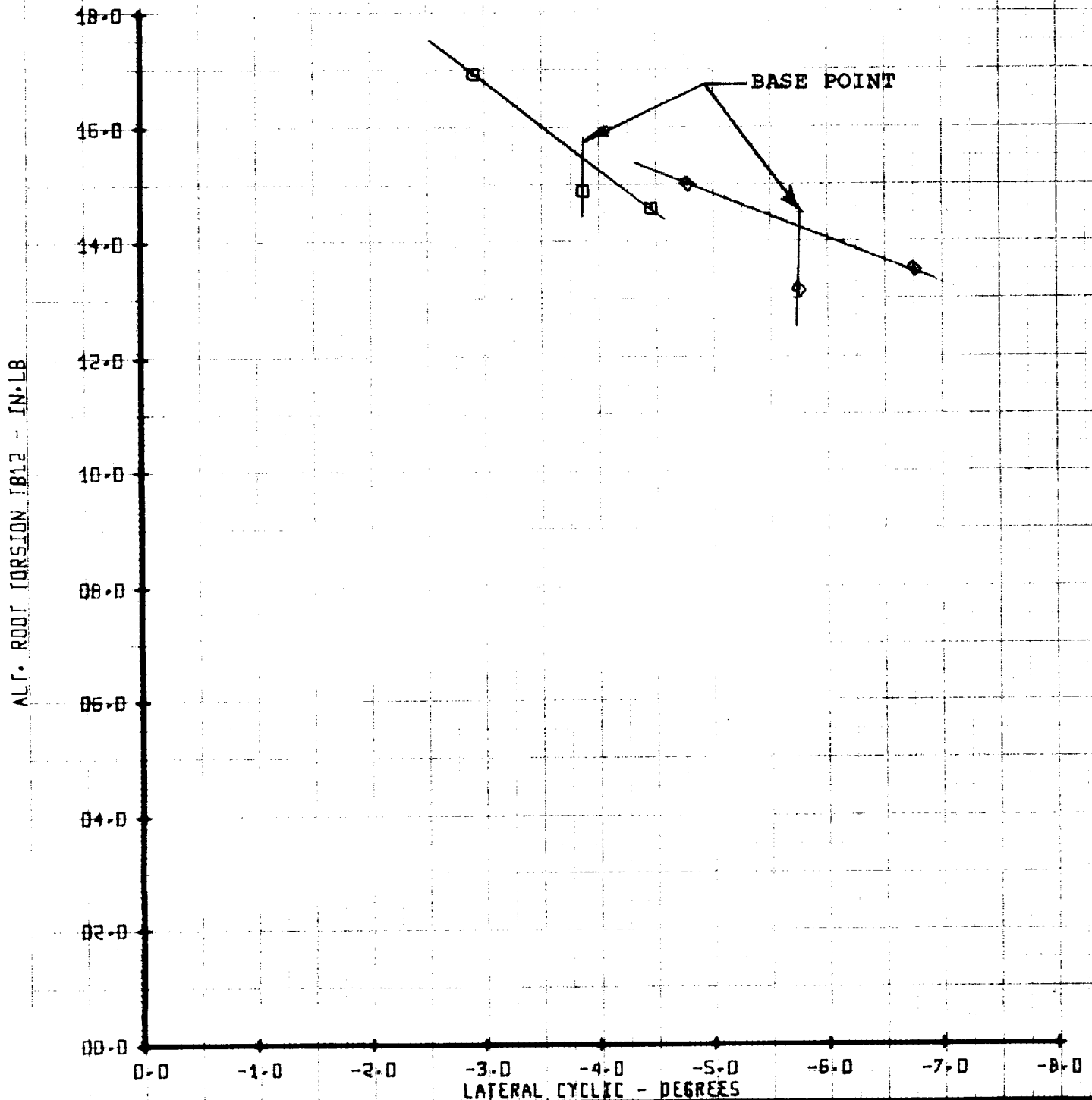


Figure C-148

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/58	VTUN
□	39	.50	.05	.078	310
◻	41	.50	.10	.069	310
◊	42	.50	.20	.059	310

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC

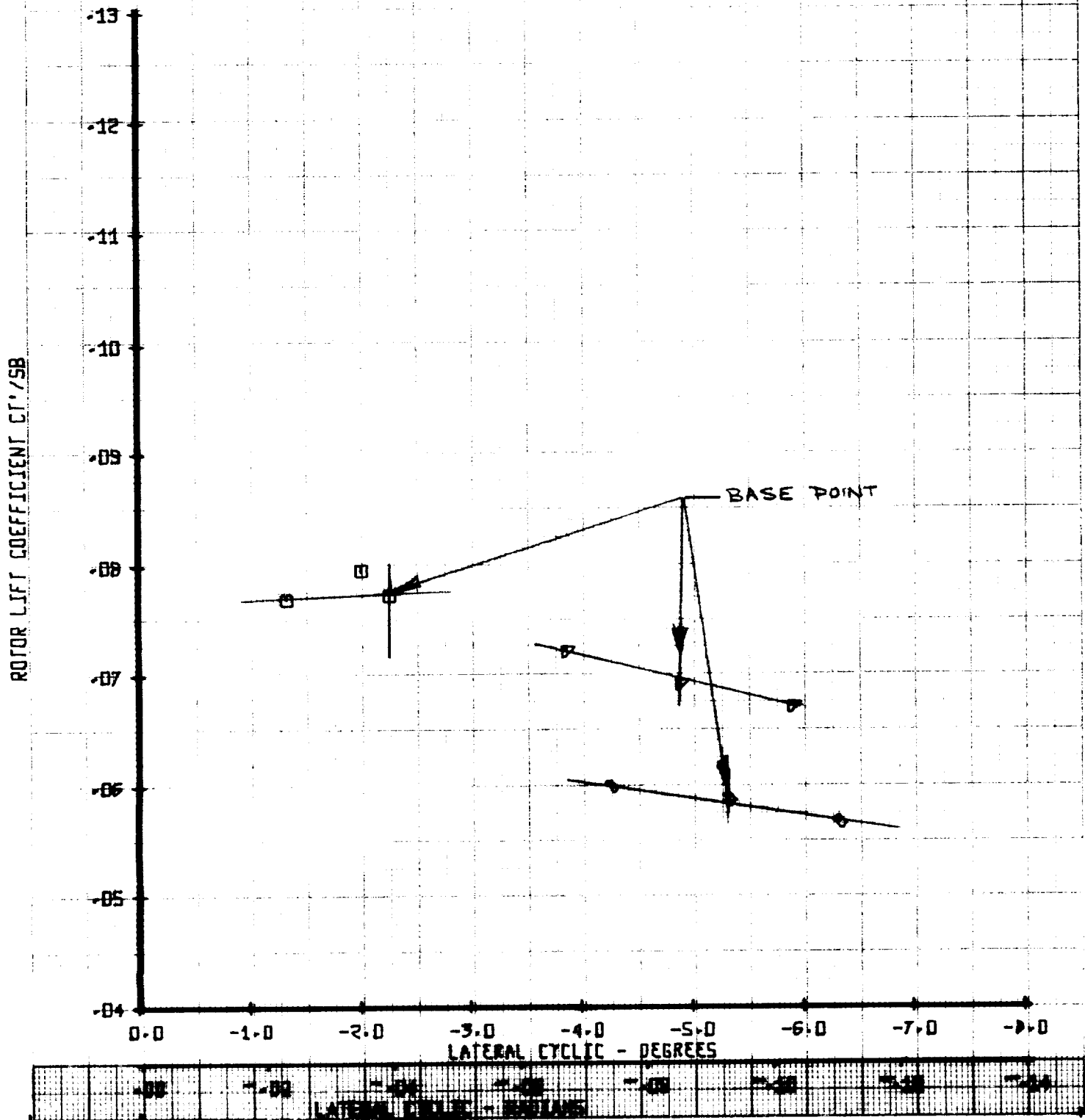


Figure C-149

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/0025B	CI'/SB	VTUN
□	39	.50	.05	.078	310
▽	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

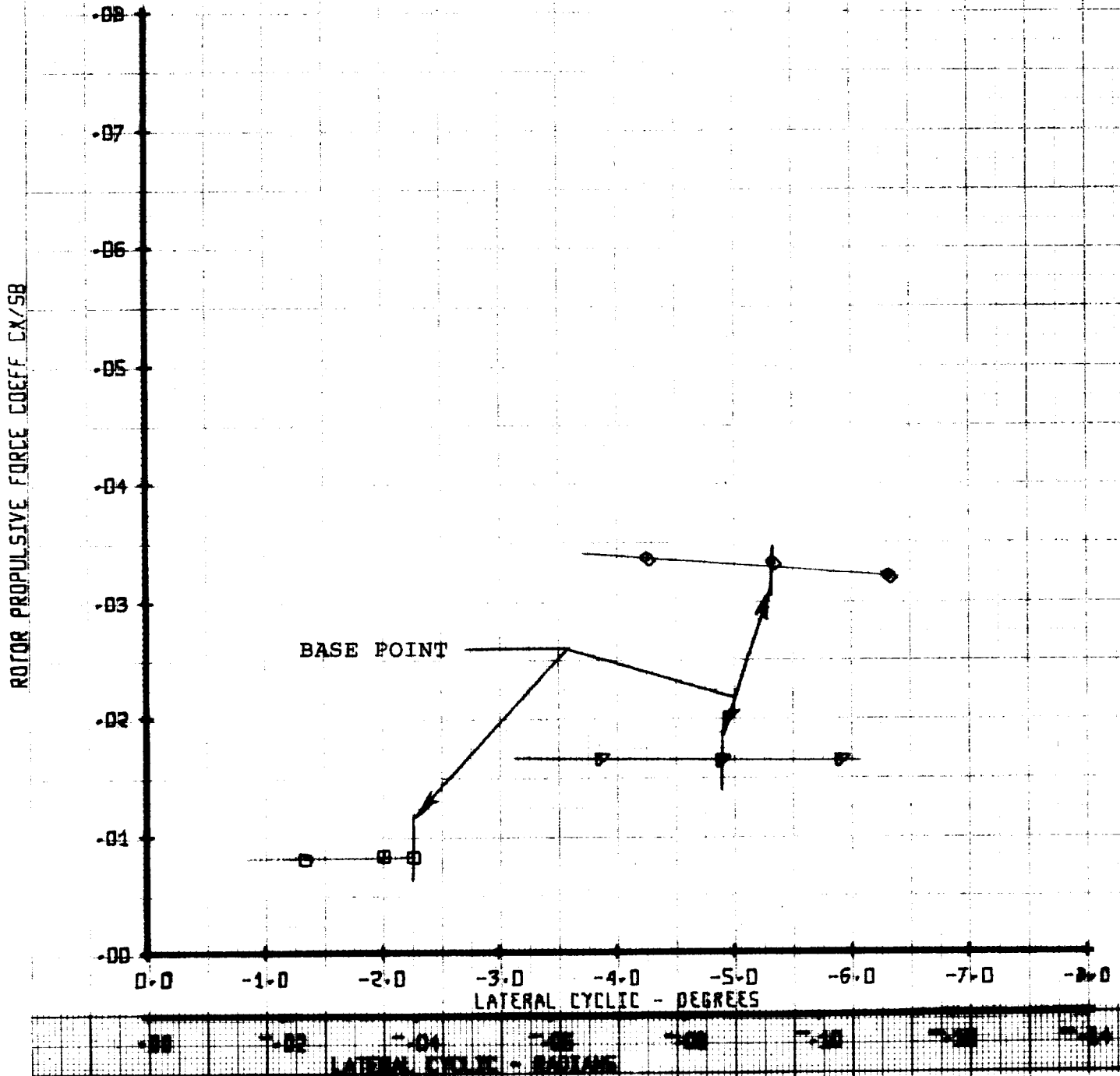


Figure C-150

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD2SB	CT'/SB	VTUN
□	39	.50	.05	.078	310
▽	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

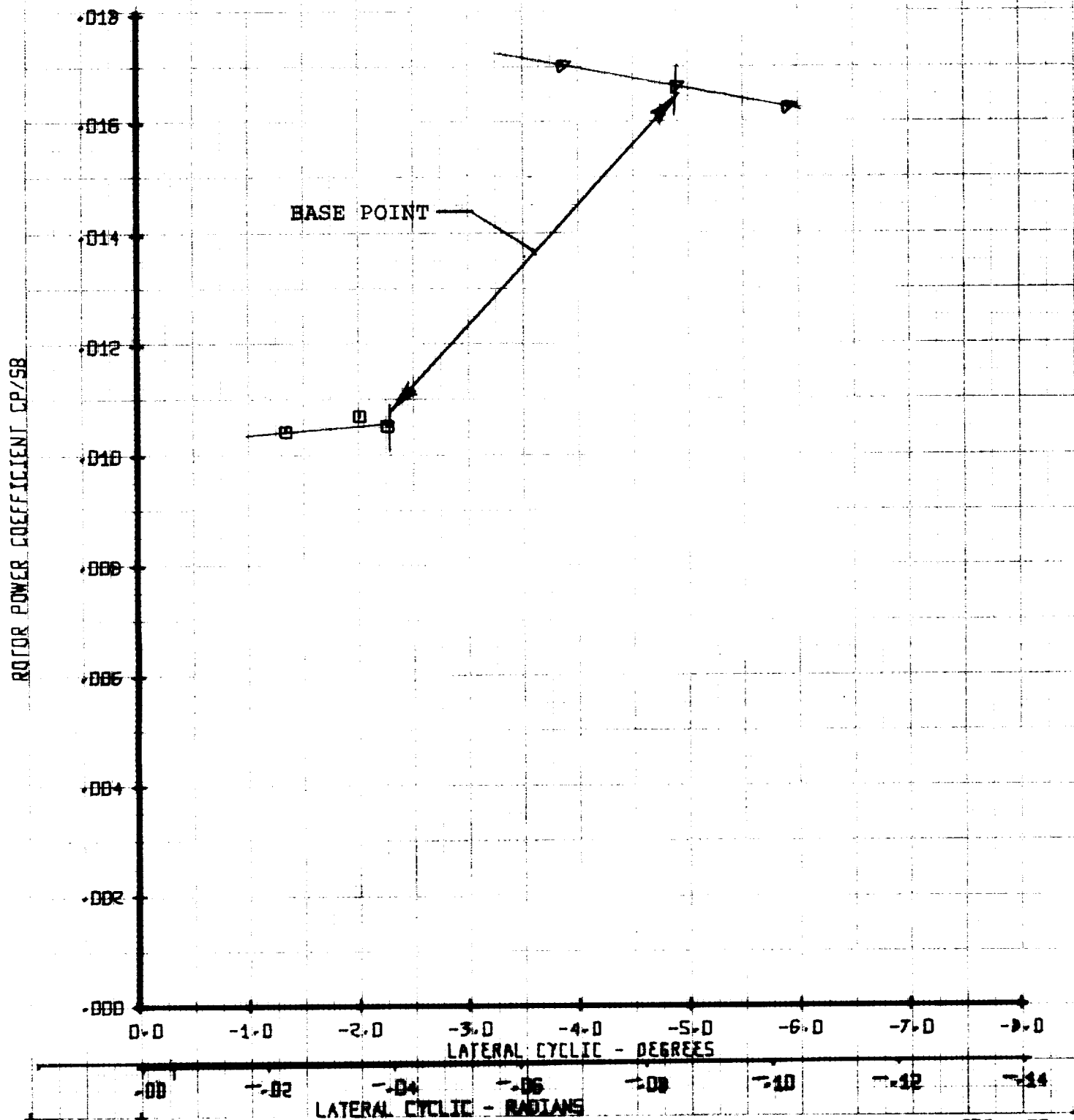
 ROTOR POWER COEFFICIENT
 VERSUS
 LATERAL CYCLIC


Figure C-151

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/D0258	CT'/SB	VTUN
□	39	.50	.05	.078	310
△	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

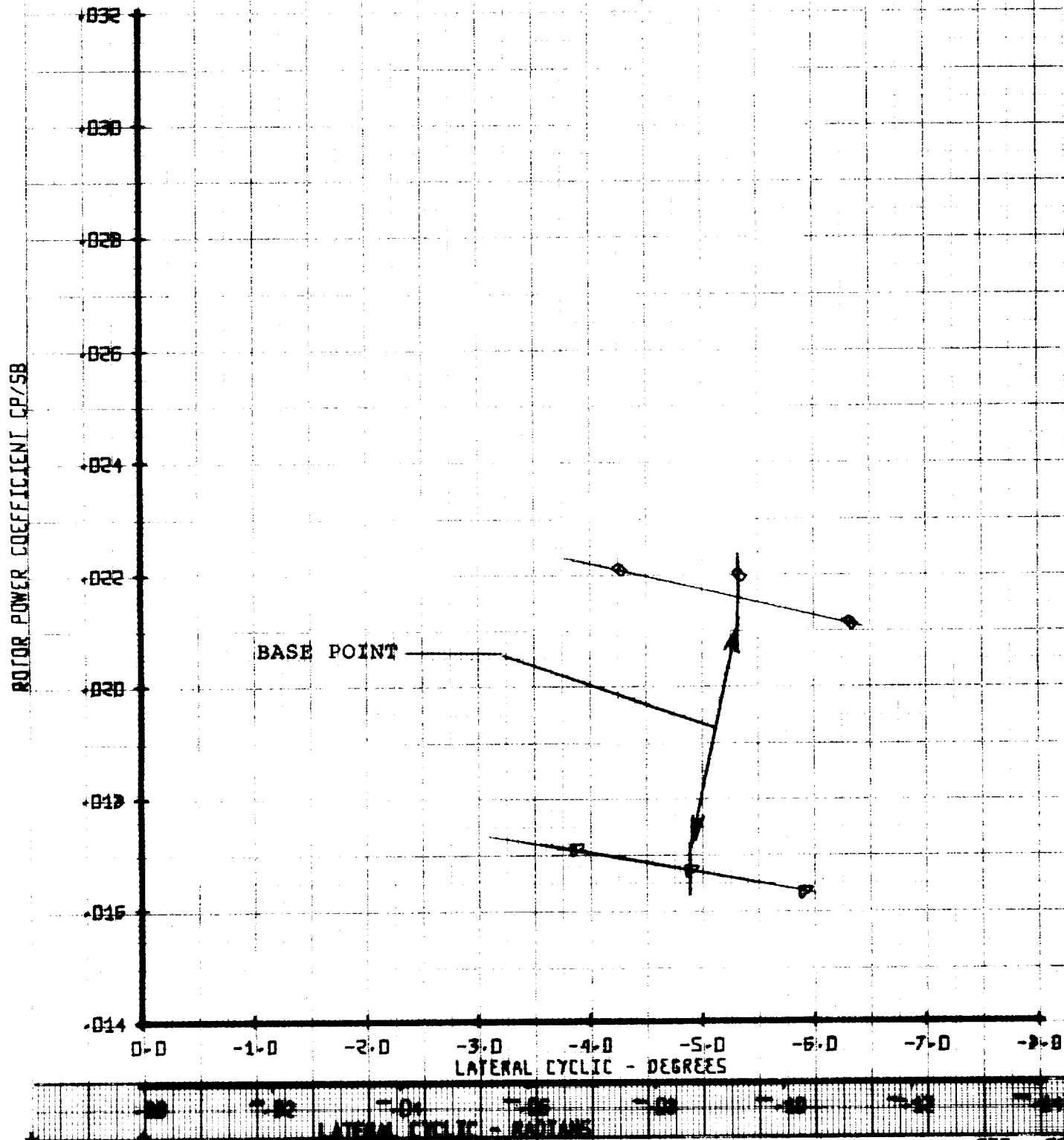


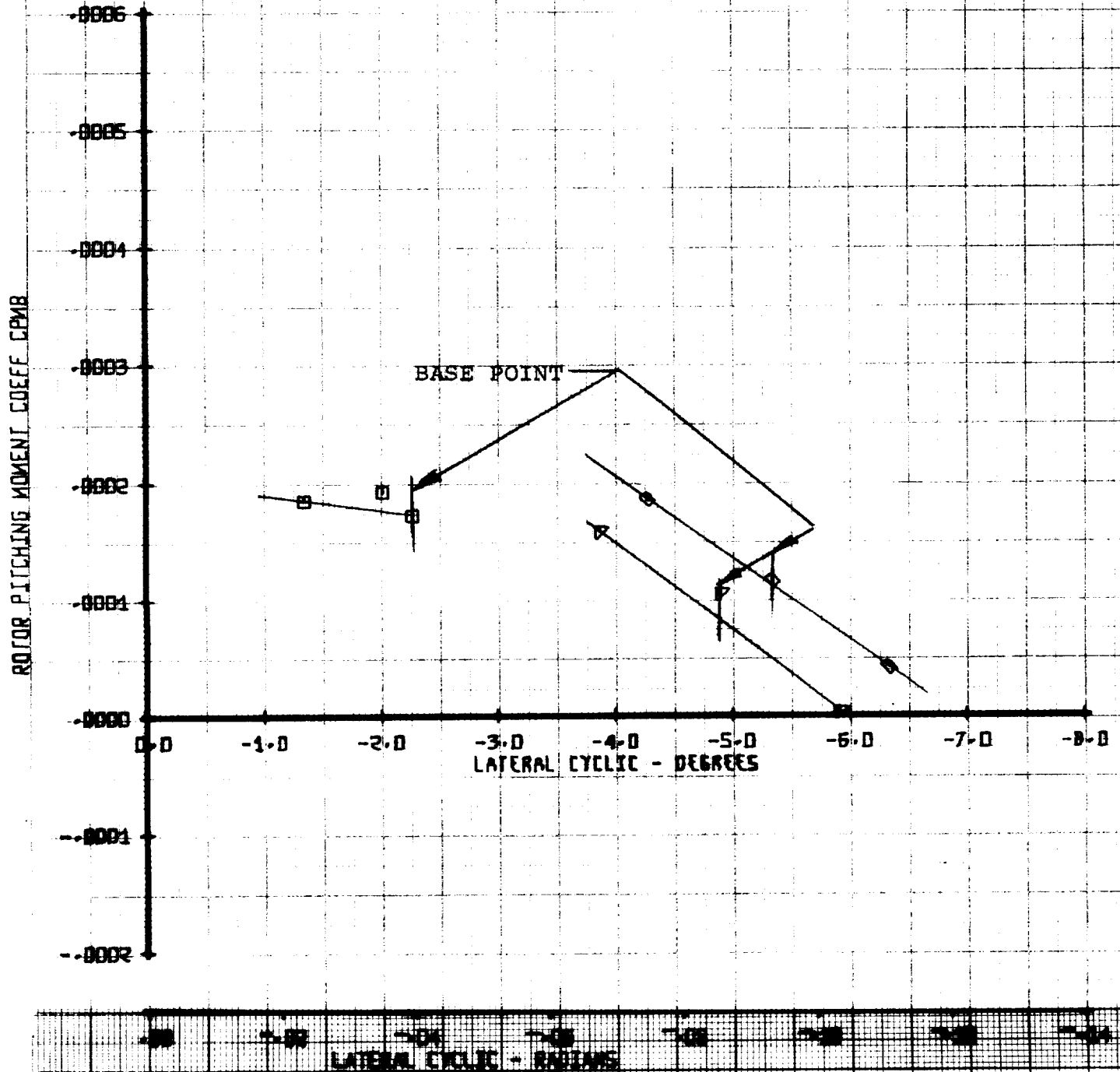
Figure C-152

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/D0258	CT'1/58	VTUN
□	39	.50	.05	.078	310
△	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
□	39	.50	.05	.078	310
◇	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

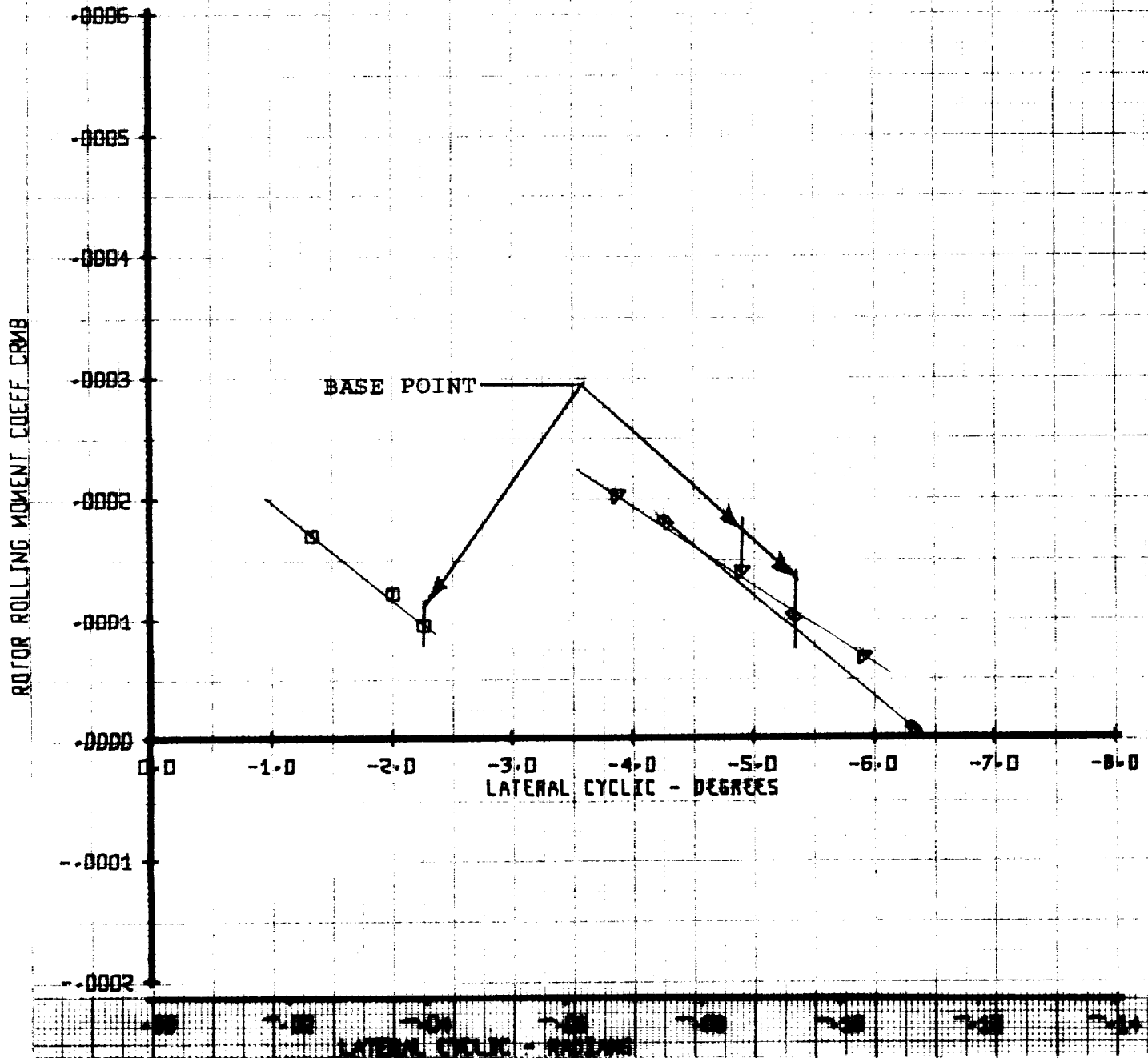


Figure C-154

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT/5B	VTUN
□	39	.50	.05	.078	310
△	41	.50	.10	.069	310
●	42	.50	.20	.059	310

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

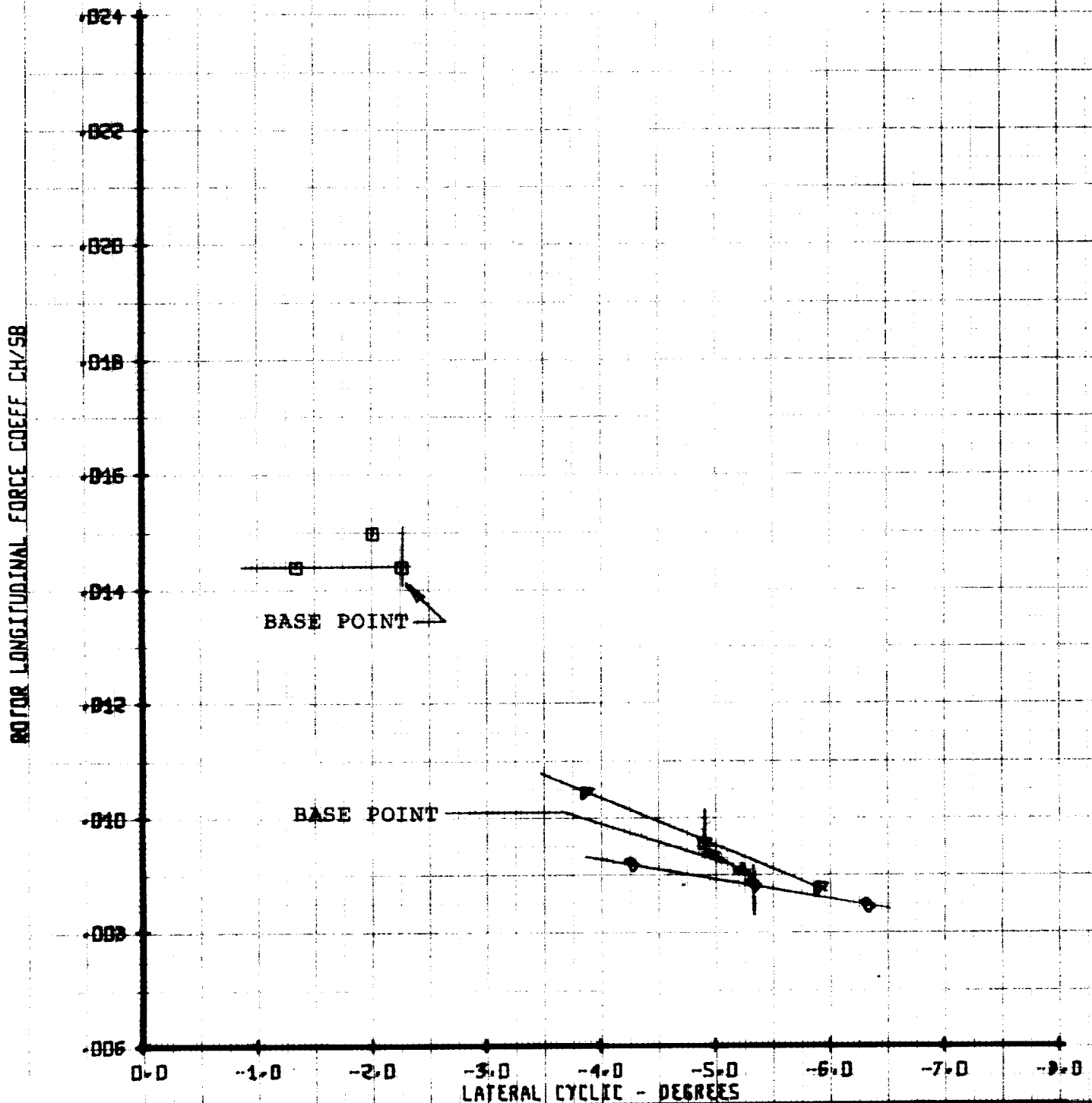


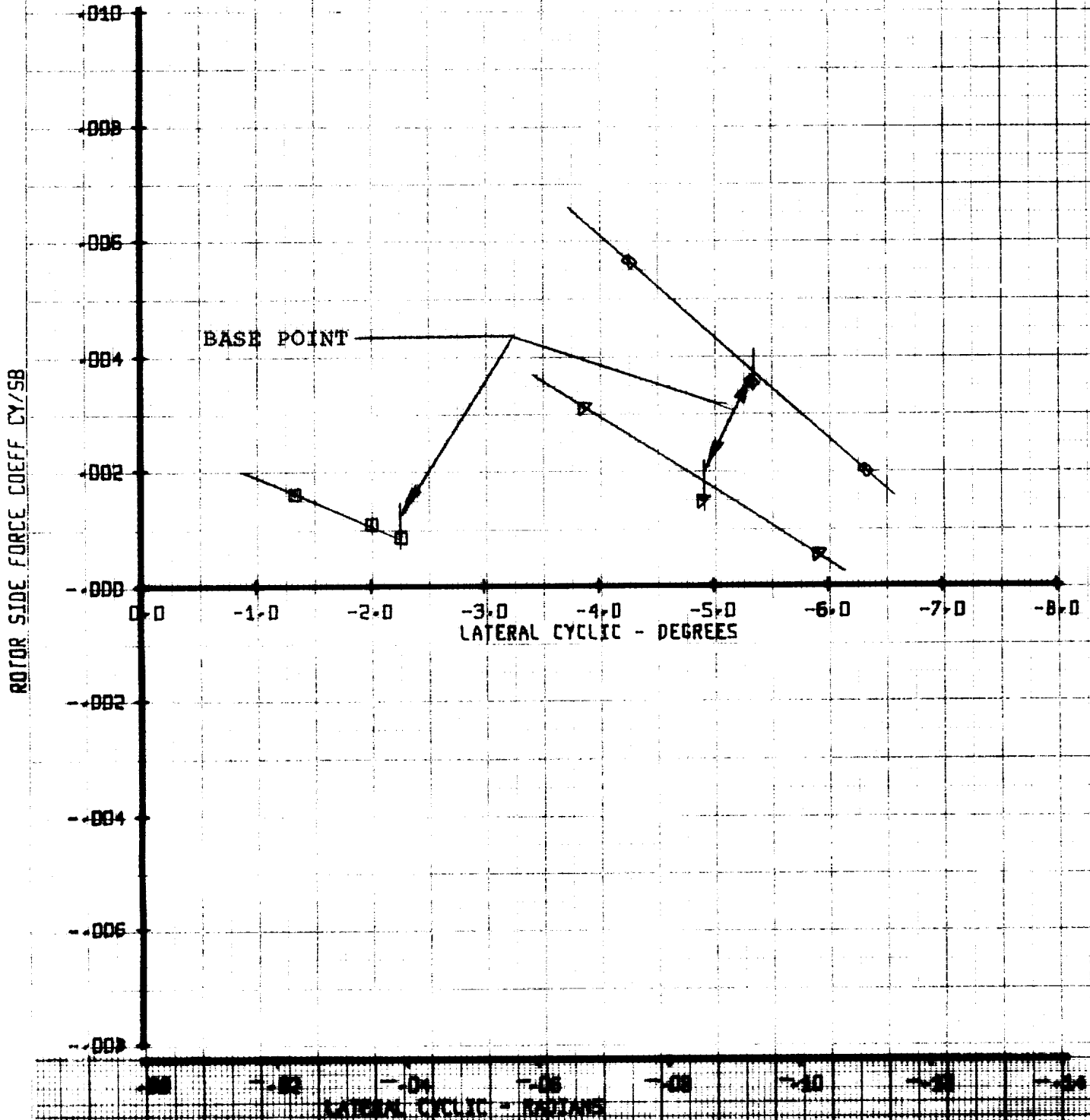
Figure C-155

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MJ	X/00258	CT'/SB	VTUN
□	39	.50	.05	.078	310
▽	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/0025B	CT'/SB	VTUN
□	39	.50	.05	.078	310
◇	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

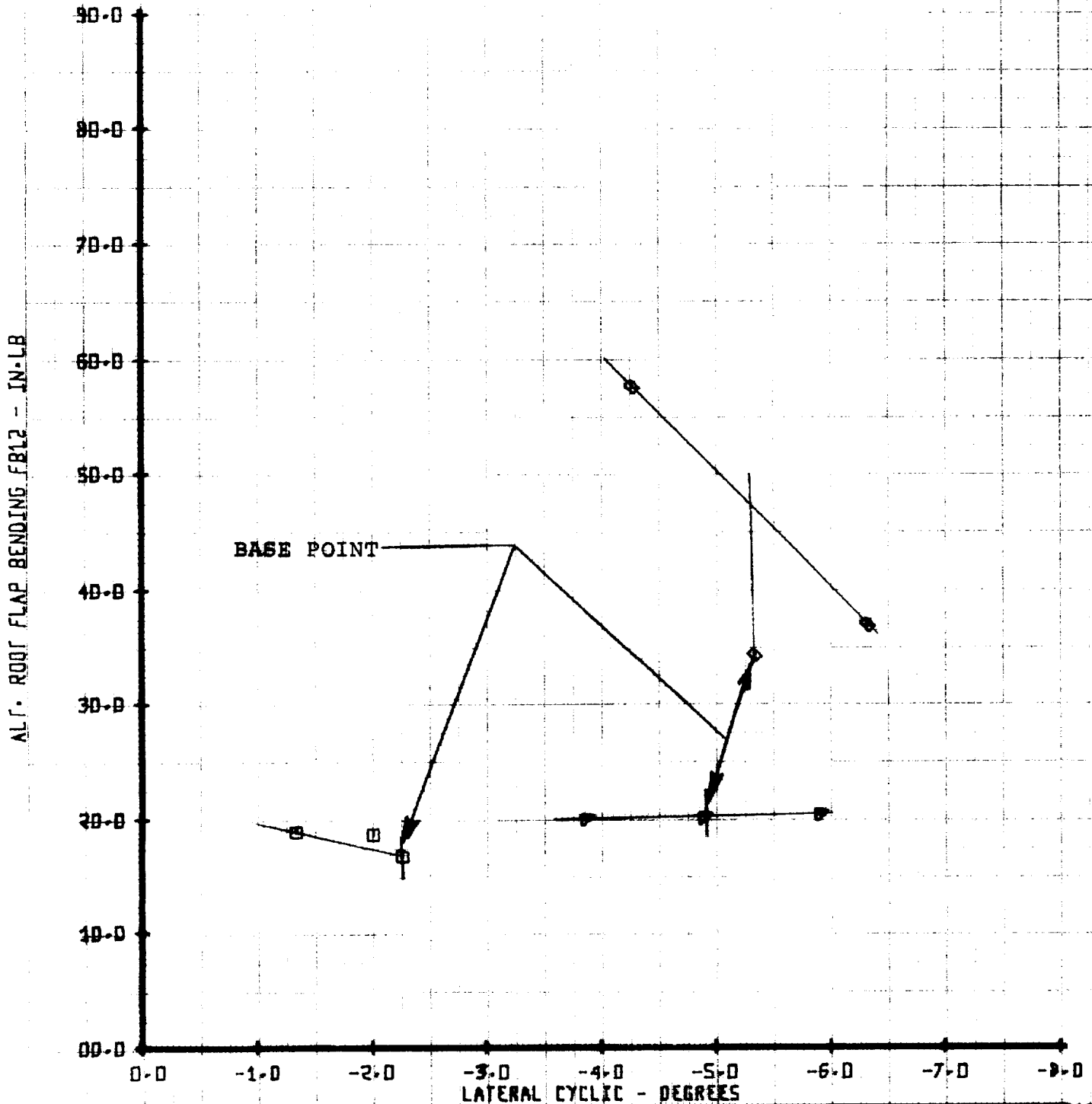


Figure C-157

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00298	CT/58	YTUN
□	39	.50	.05	.078	310
△	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ALTERNATING ROOT TORSION TB12
VERSUS
LATERAL CYCLIC

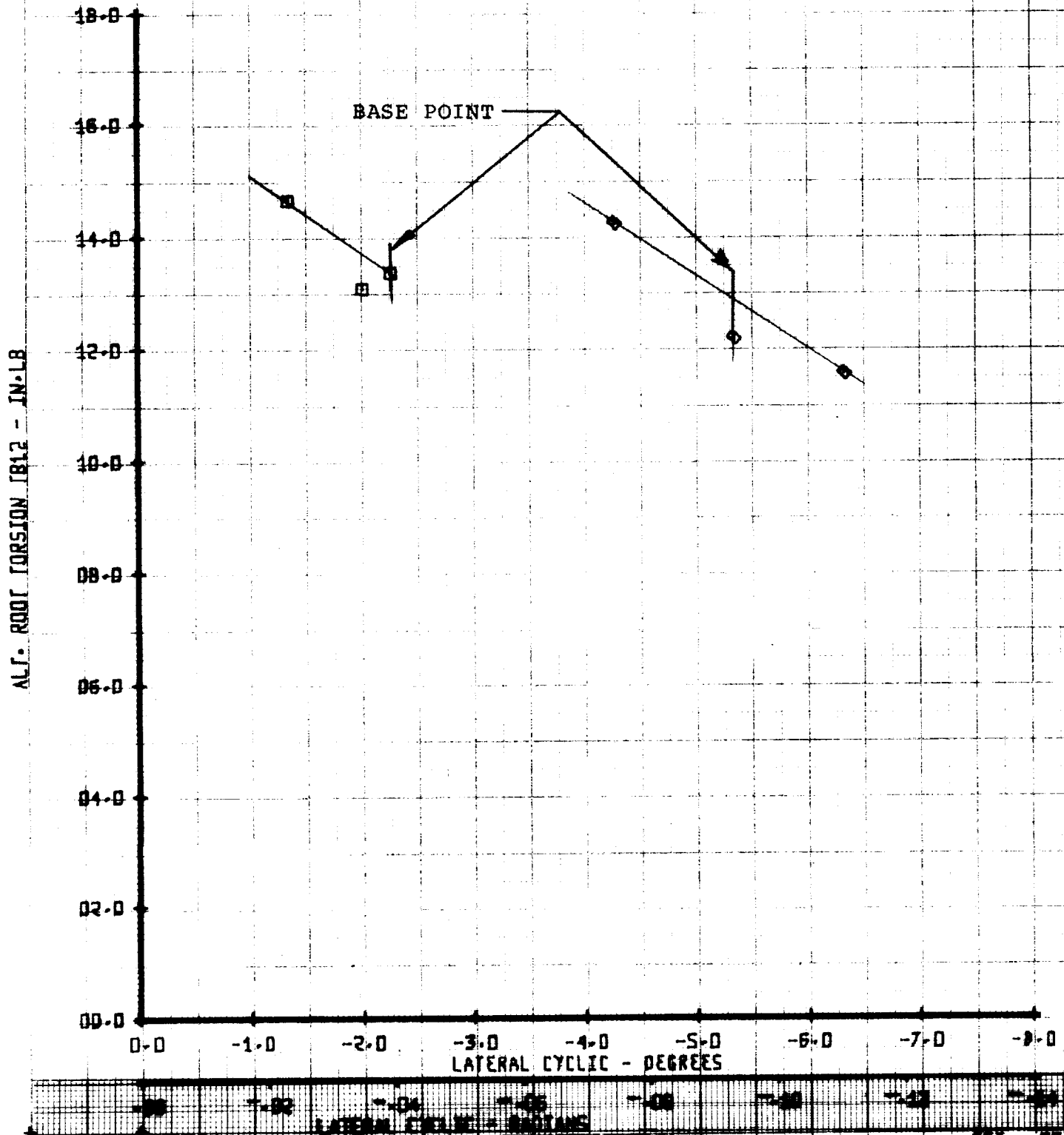


Figure C-158

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00250	CT'/SB	VTUN
□	39	.50	.05	.098	310
△	39	.50	.05	.078	310

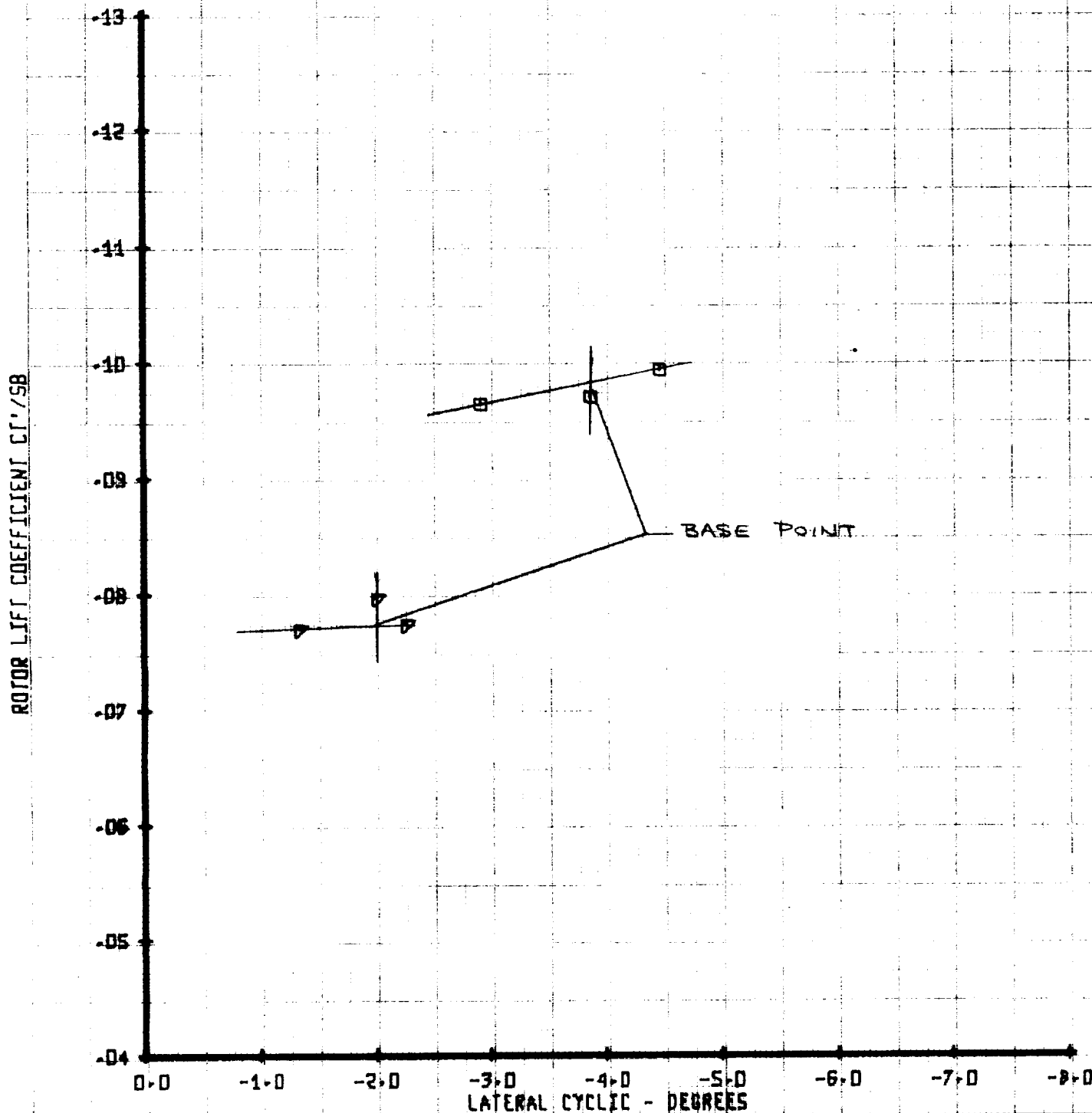
 ROTOR LIFT COEFFICIENT
 VERSUS
 LATERAL CYCLIC


Figure C-159

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE OH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT/98	VILN
□	39	.50	.05	.098	310
△	39	.50	.05	.078	310

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LATERAL CYCLIC

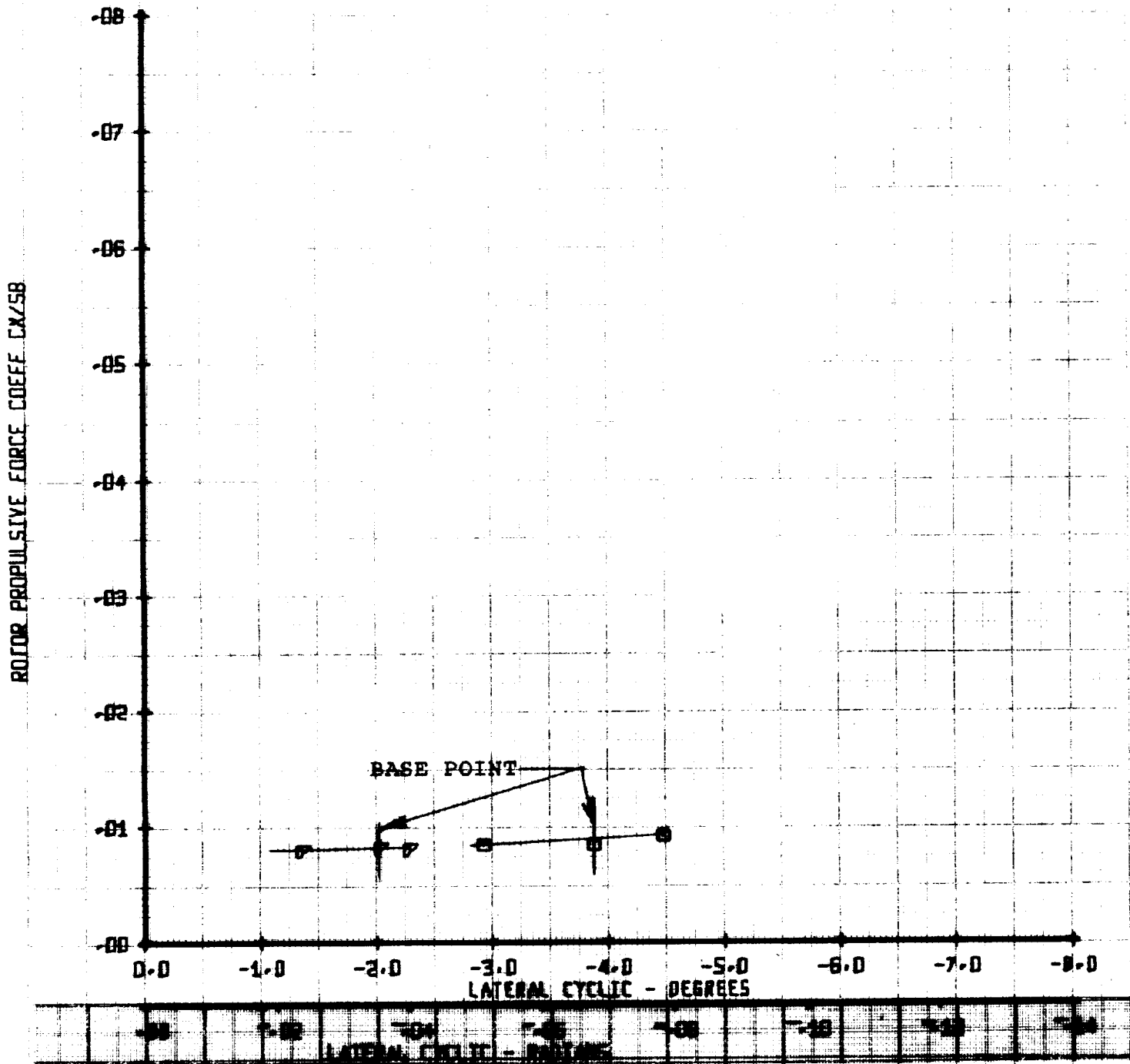


Figure C-160

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/00258	CT/58	Y/TUN
□	39	.50	.05	.098	310
○	39	.50	.05	.078	310

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

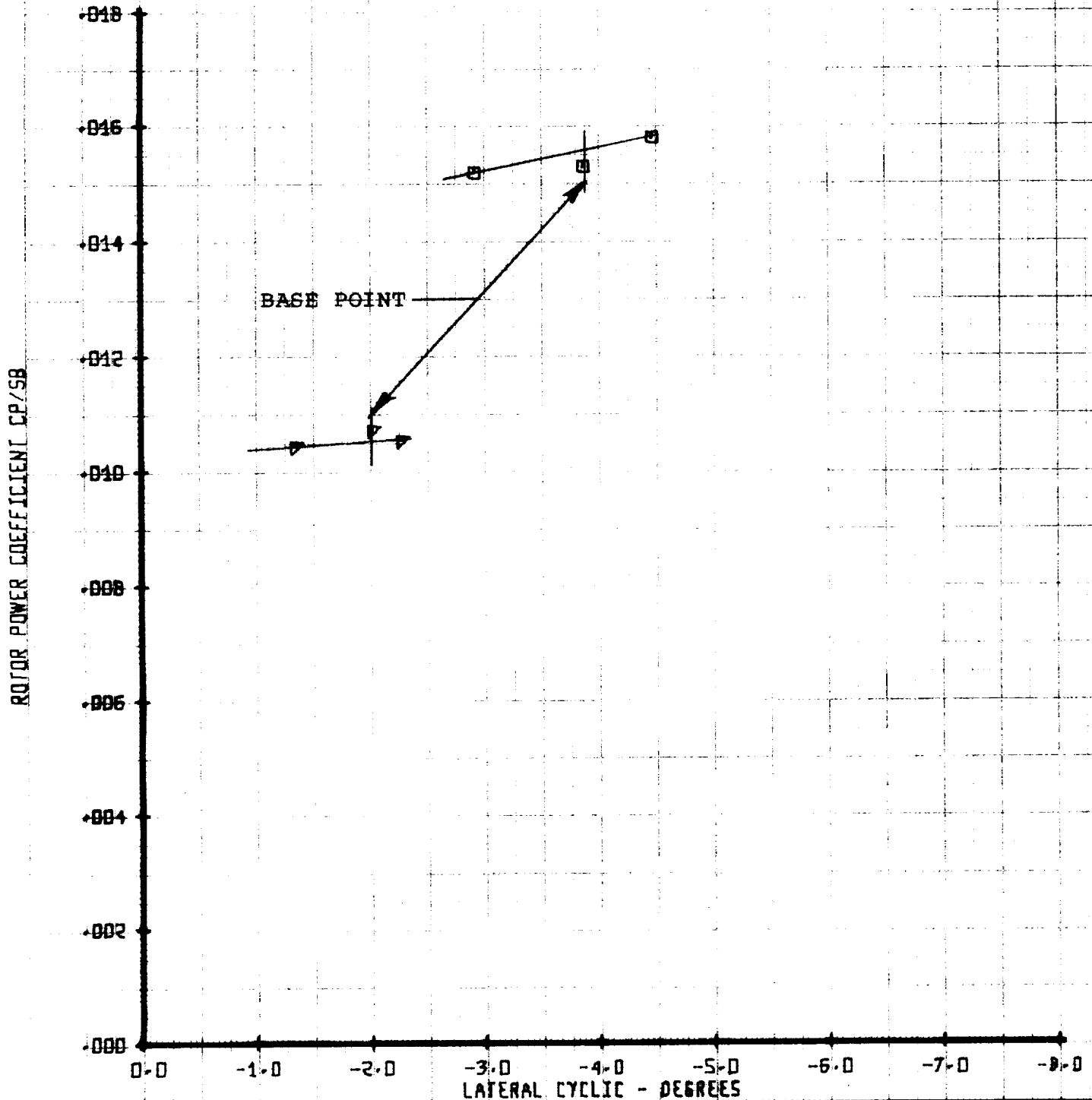


Figure C-161

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
□	39	.50	.05	.098	310
▽	39	.50	.05	.078	310

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

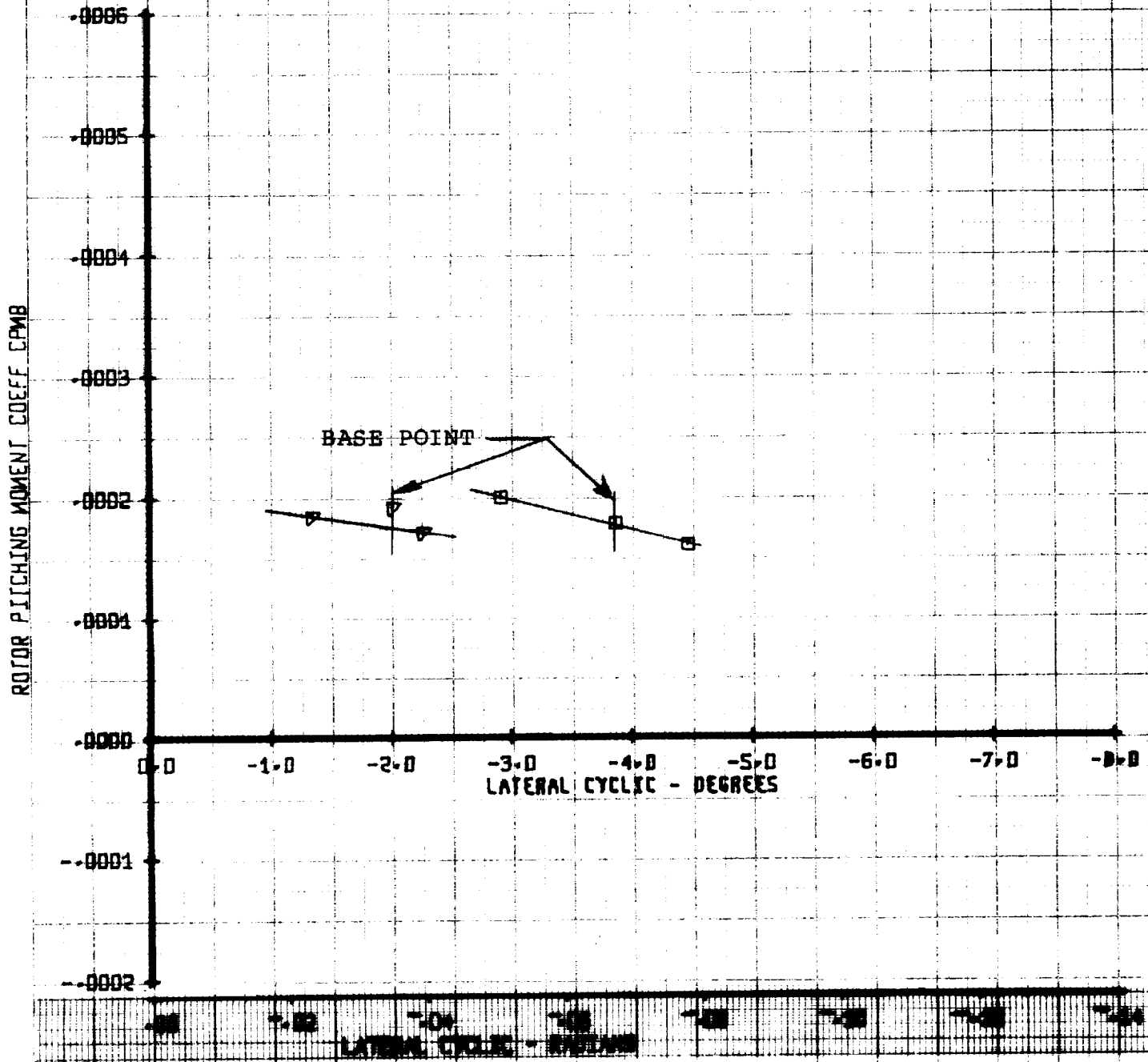


Figure C-162

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/58	VTUN
□	39	.50	.05	.098	310
△	39	.50	.05	.078	310

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

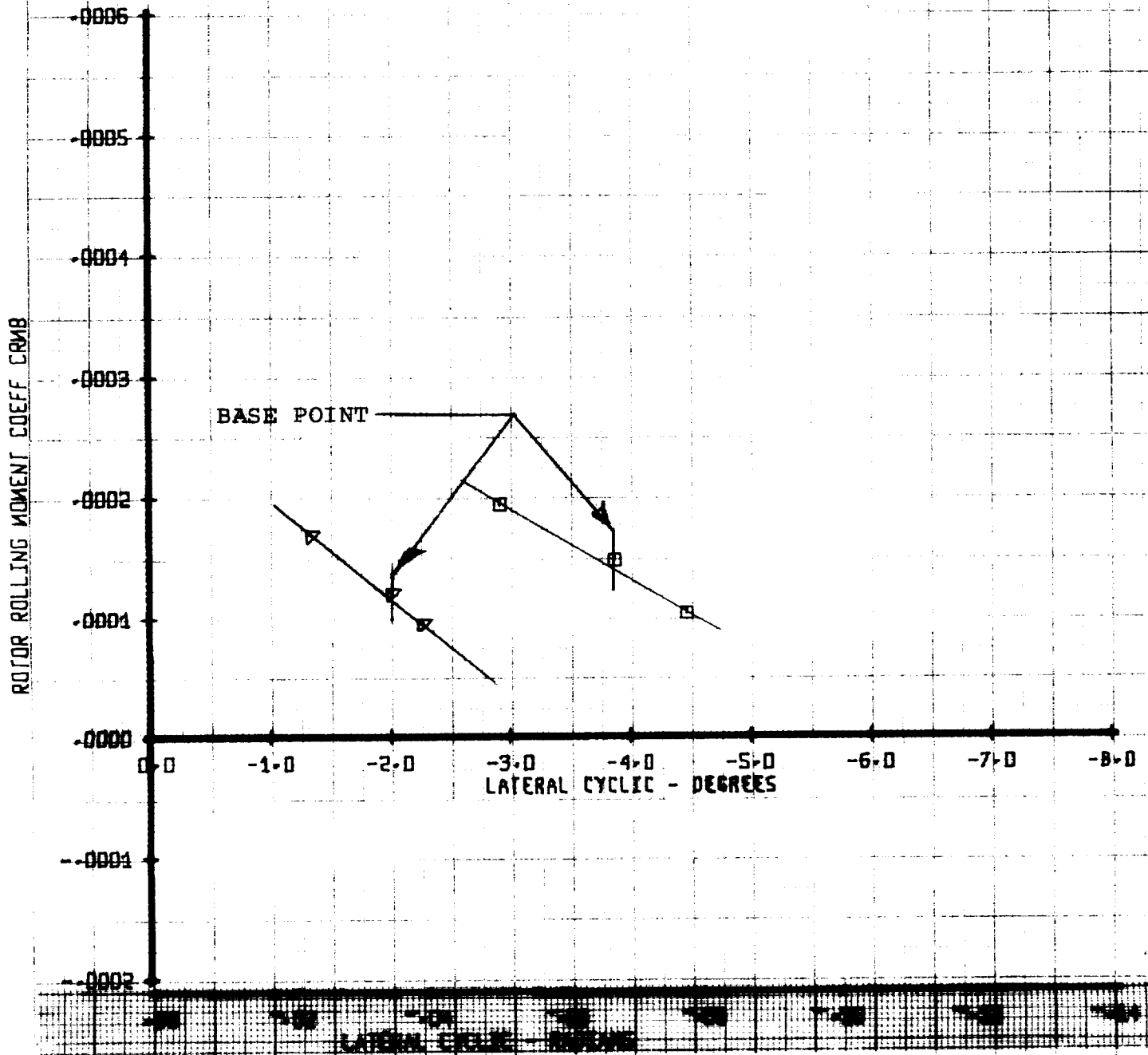


Figure C-163

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT'/SB	VTUN
□	39	.50	.05	.098	310
▽	39	.50	.05	.078	310

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

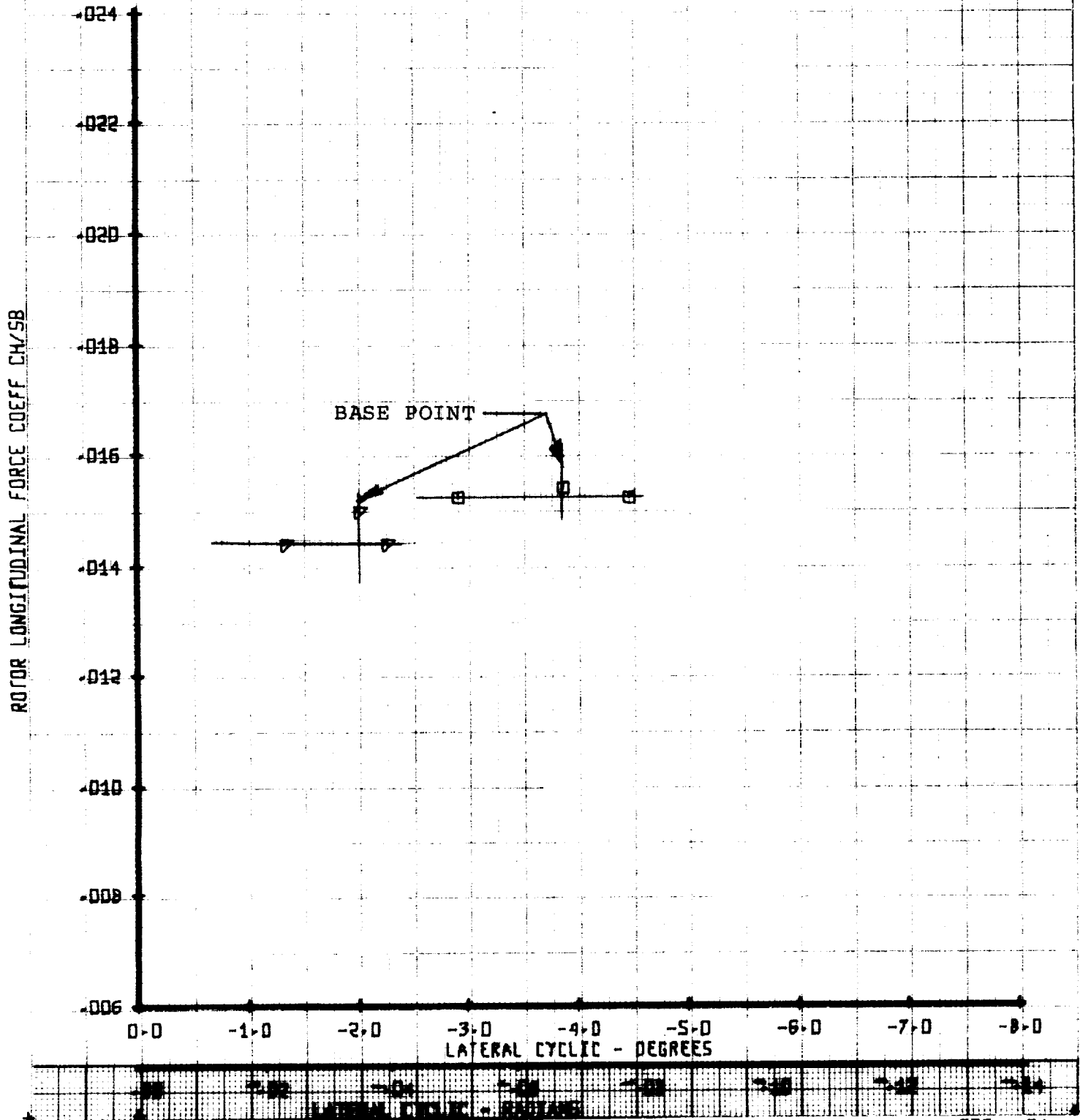


Figure C-164

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE OH-475 ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT/58	VTUN
9	39	.50	.05	.098	310
9	39	.50	.05	.078	310

ROTOR SIDE FORCE COEFFICIENT
 VERSUS
 LATERAL CYCLIC

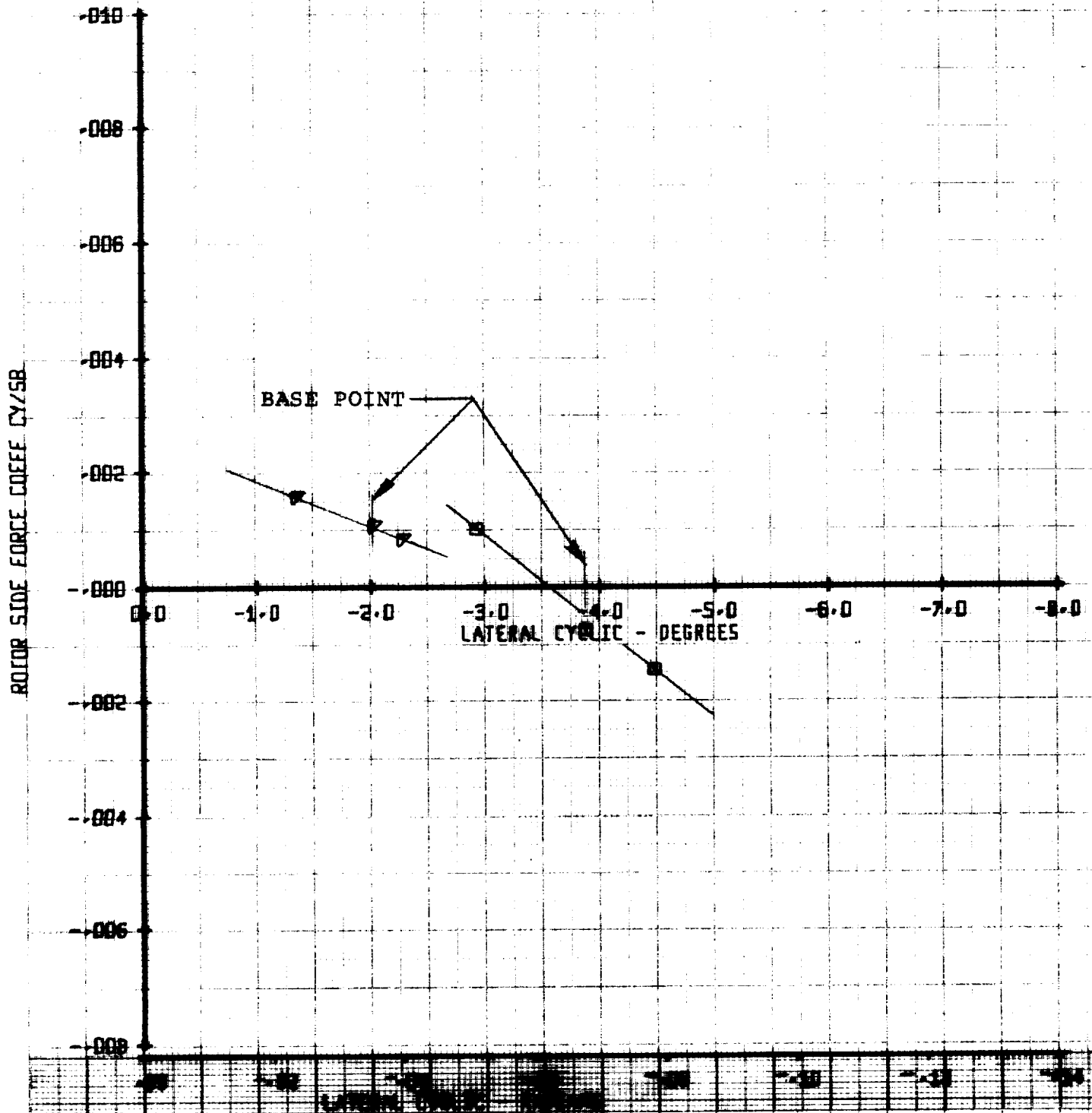


Figure C-165

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MI'	X/00258	CT'/SB	VTUN
0	39	.50	.05	.098	310
7	39	.50	.05	.078	310

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

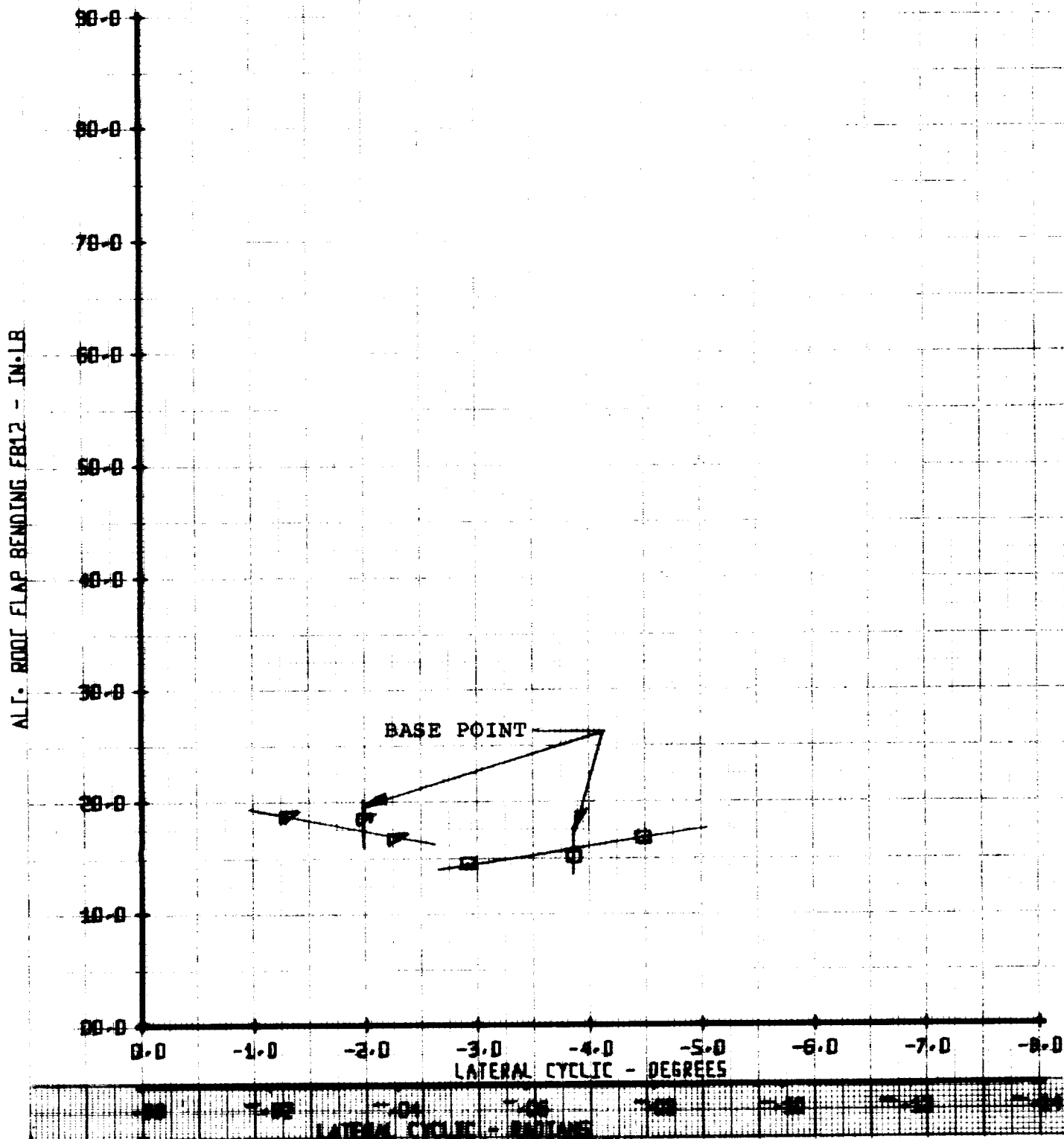


Figure C-166

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DO258	CT'/SE	VTUN
□	39	.50	.05	.098	310
△	39	.50	.05	.078	310

ALTERNATING ROOT TORSION TB12
VERSUS
LATERAL CYCLIC

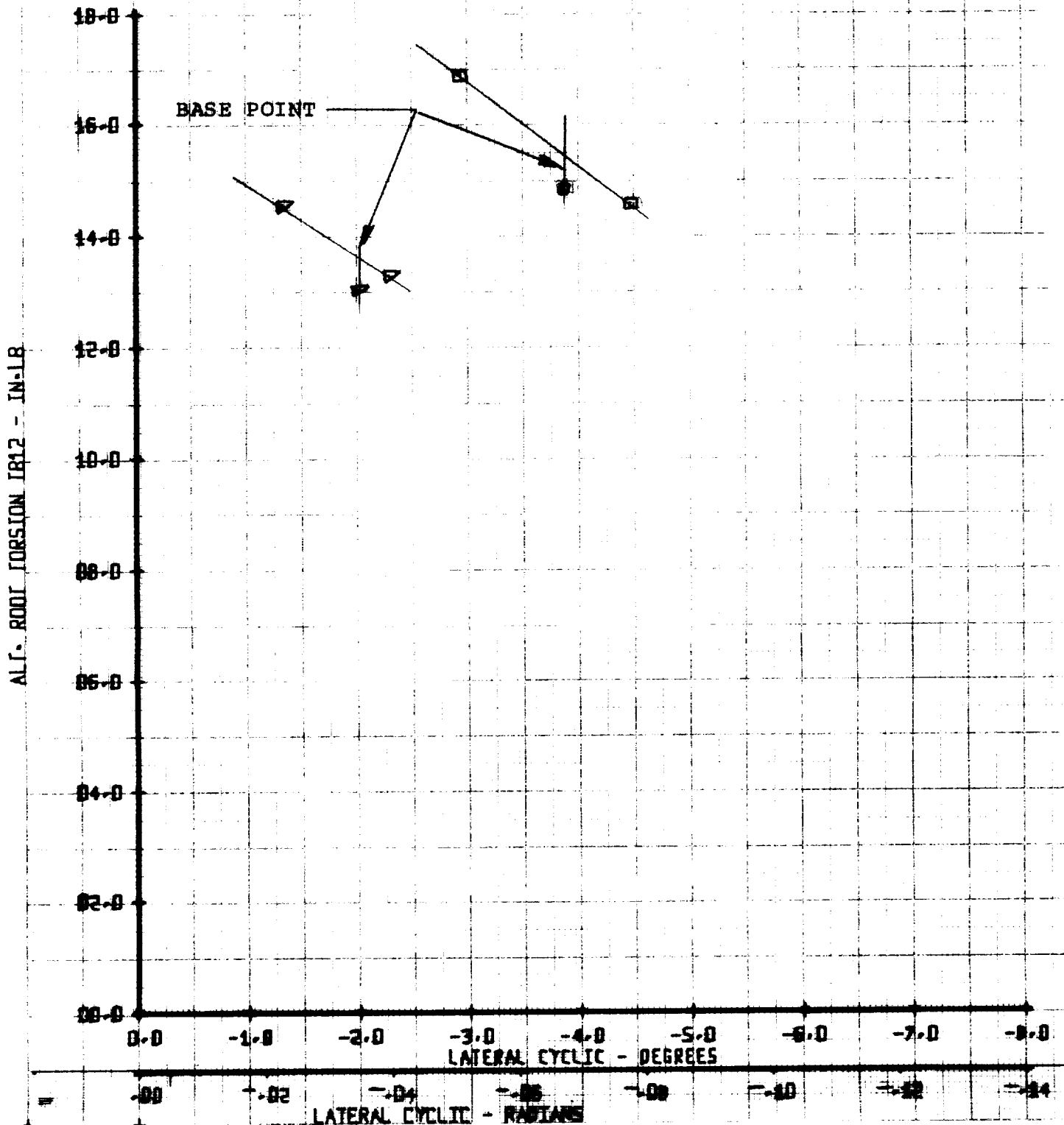


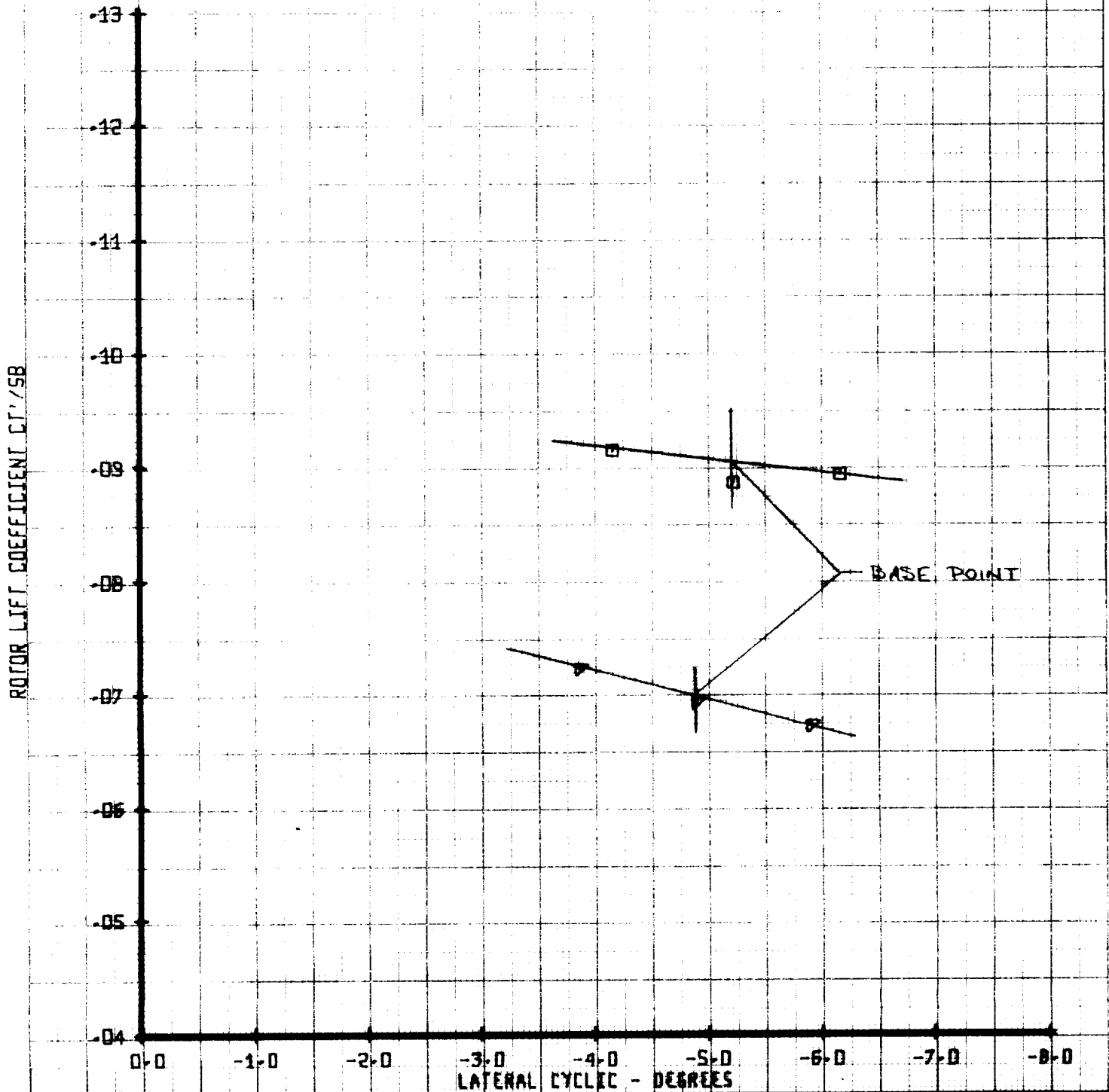
Figure C-167

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD2SB	CT'/SB	VTUN
□	41	.50	.10	.090	310
●	41	.50	.10	.069	310

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/0025B	CT'/SB	VTUN
□	41	.50	.10	.090	310
◻	41	.50	.10	.069	310

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

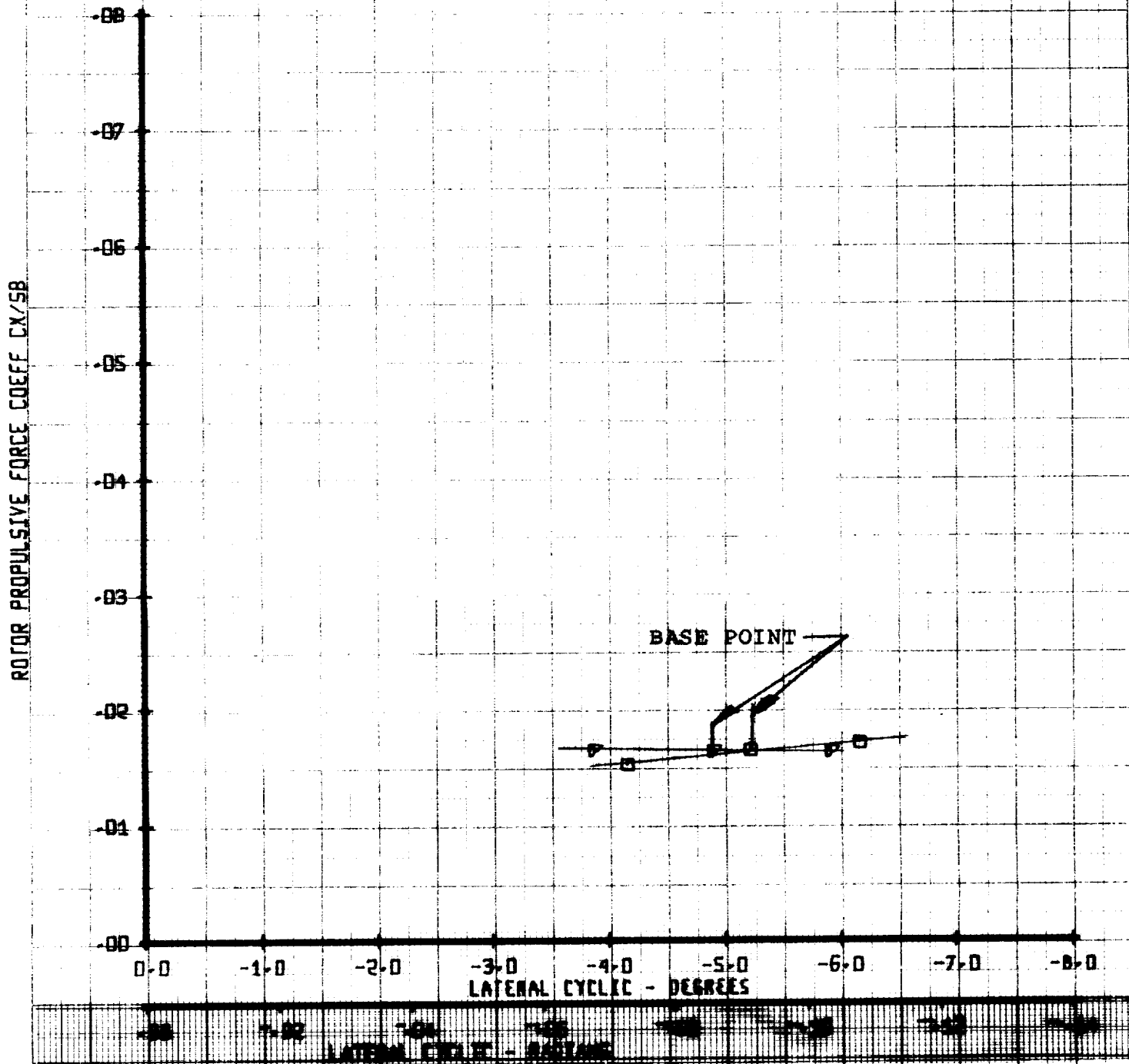


Figure C-169

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT'/SB	VTUN
□	41	.50	.10	.090	310
◻	41	.50	.10	.069	310

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

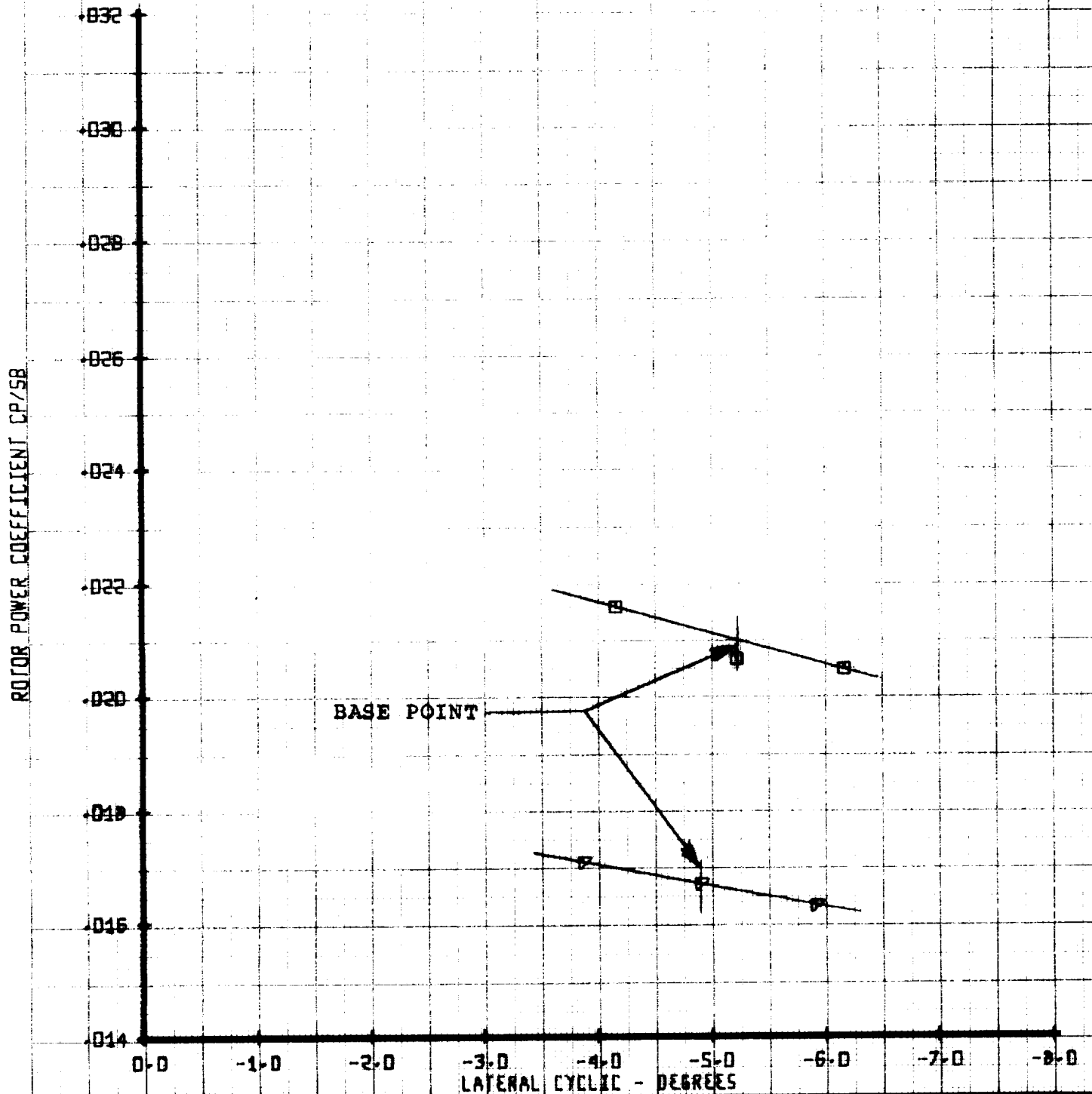


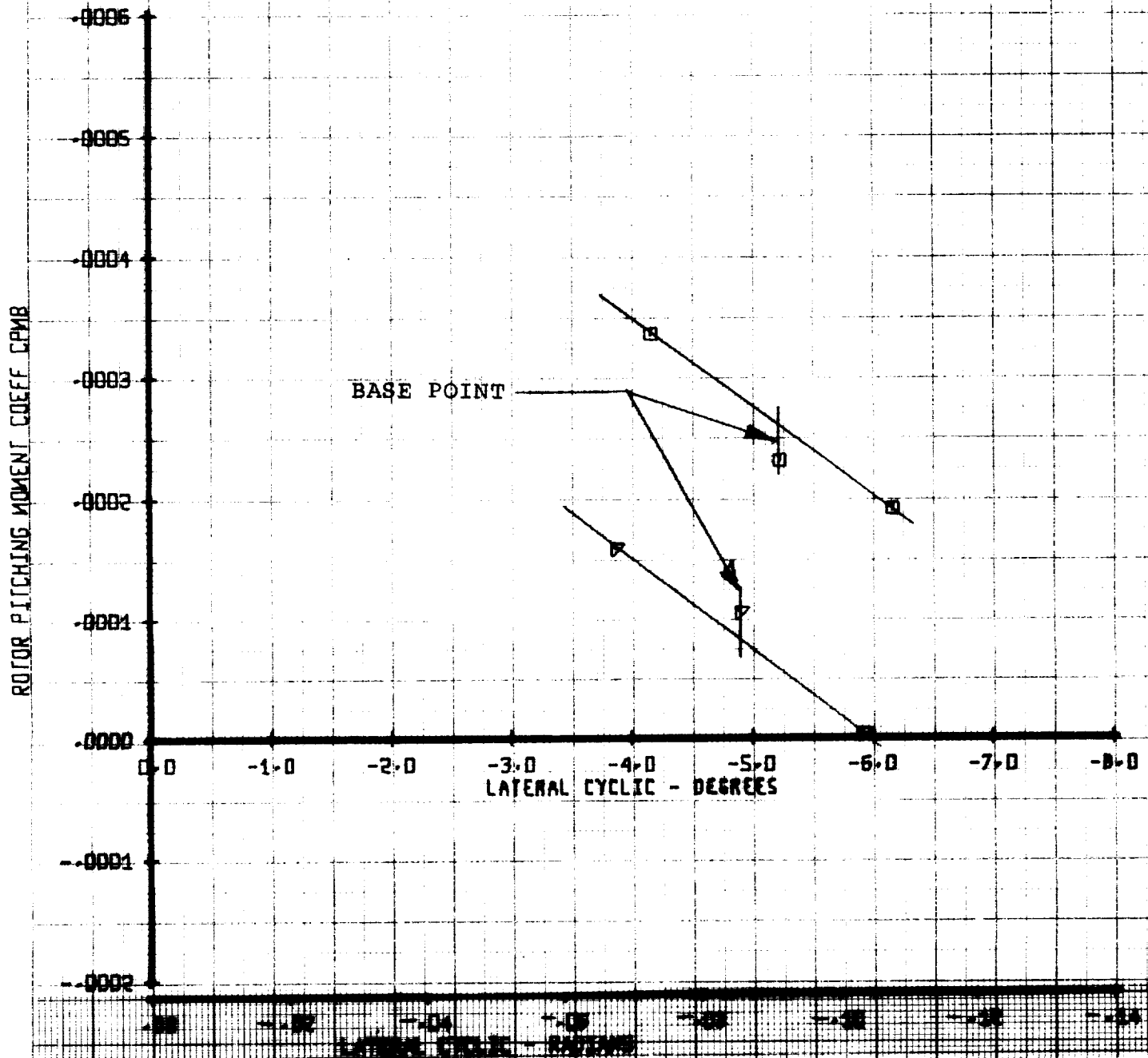
Figure C-170

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUH
□	41	.50	.10	.090	310
▽	41	.50	.10	.069	310

ROTOR PITCHING MOMENT COEFFICIENT
 VERSUS
 LATERAL CYCLIC



SET 25
 BVWT 187

Figure C-171

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD2SB	CT'/SB	YTUN
□	41	.50	.10	.090	310
▽	41	.50	.10	.069	310

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

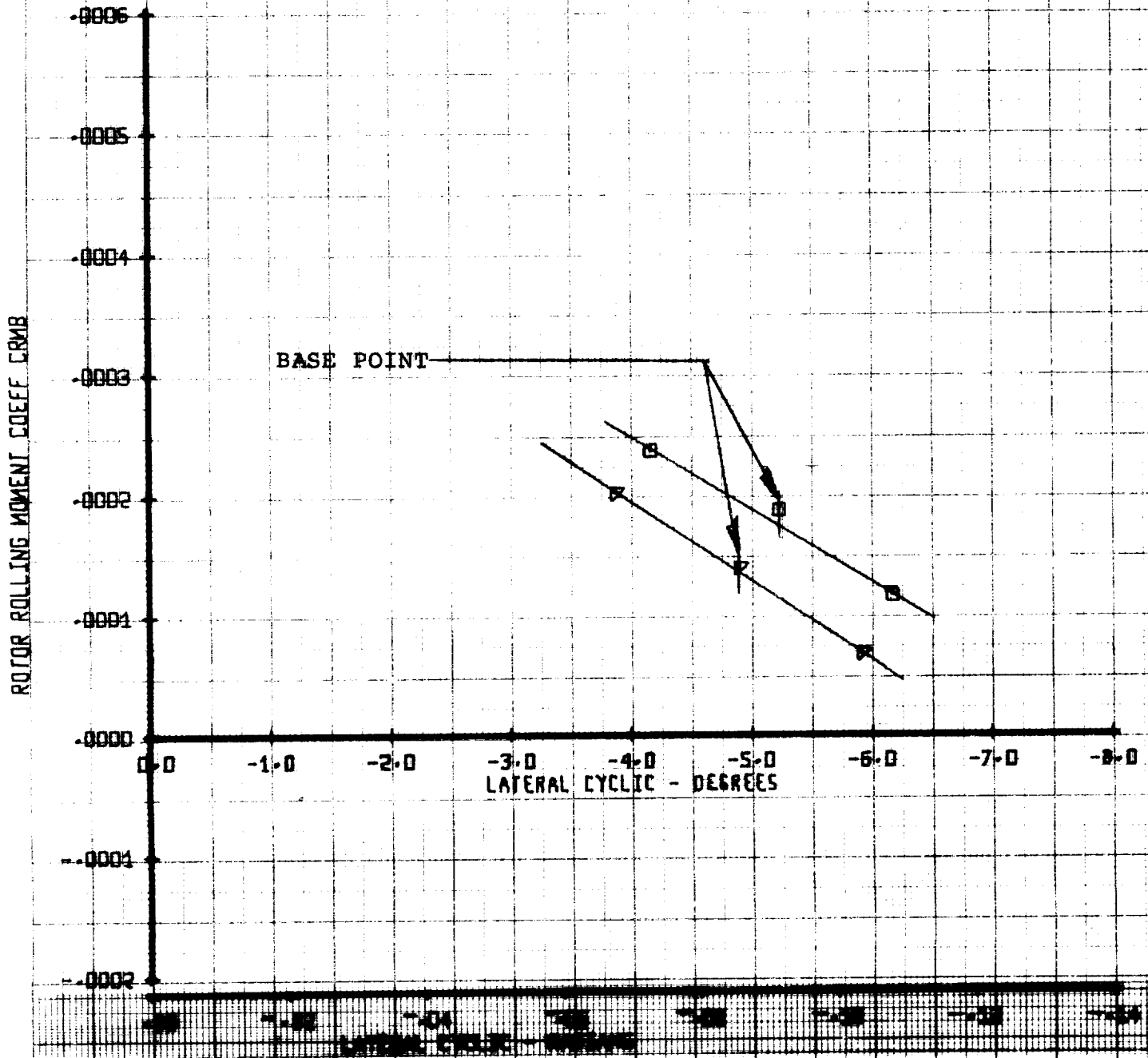


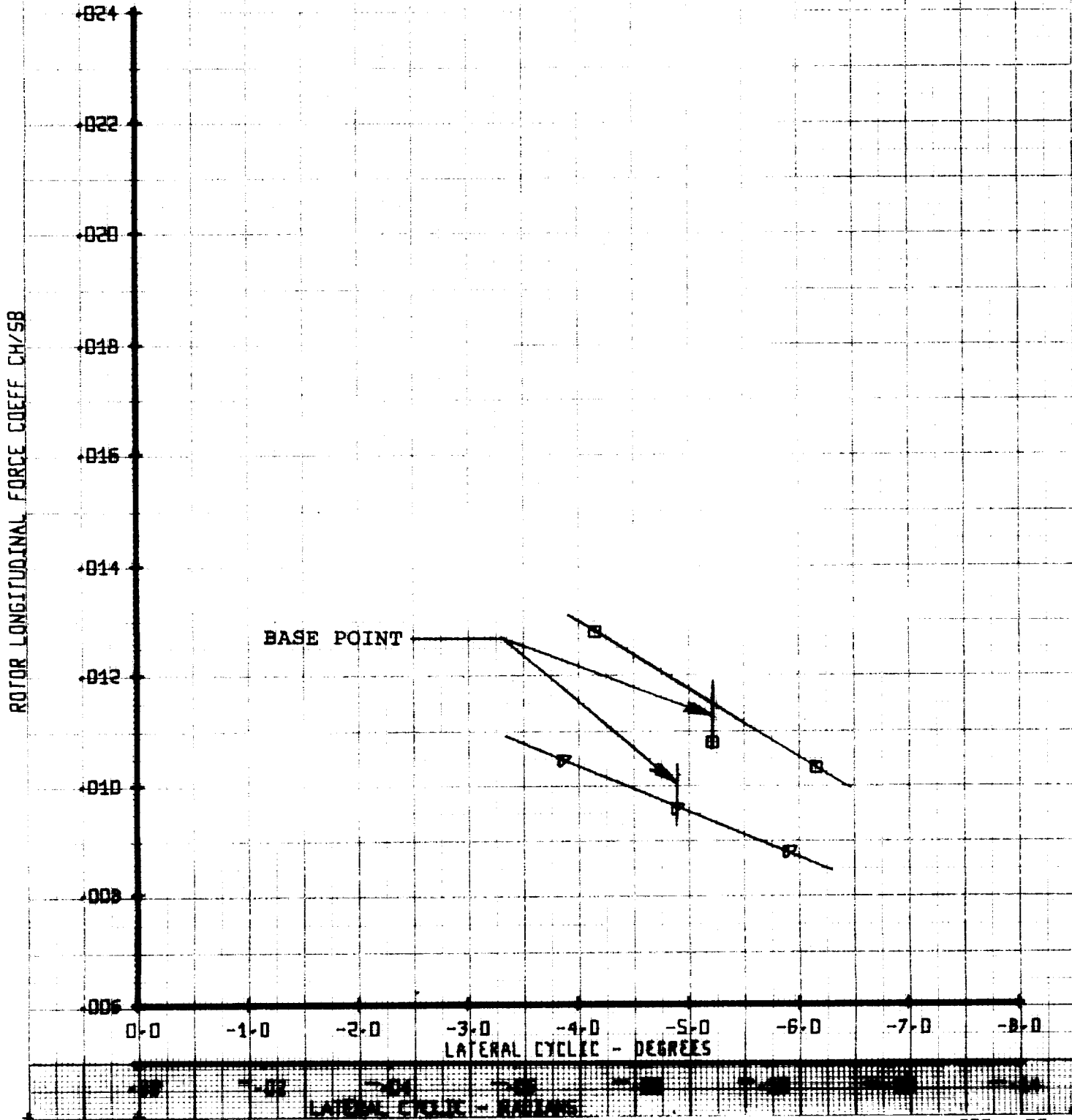
Figure C-172

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/00258	CT/58	VTUN
□	41	.50	.10	.090	310
▽	41	.50	.10	.069	310

ROTOR LONGITUDINAL FORCE COEFFICIENT
 VERSUS
 LATERAL CYCLIC



SET 25
 SVWT 187

Figure C-173

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/0025B	CT'/SB	YTLIN
□	41	.50	.10	.090	310
▽	41	.50	.10	.069	310

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

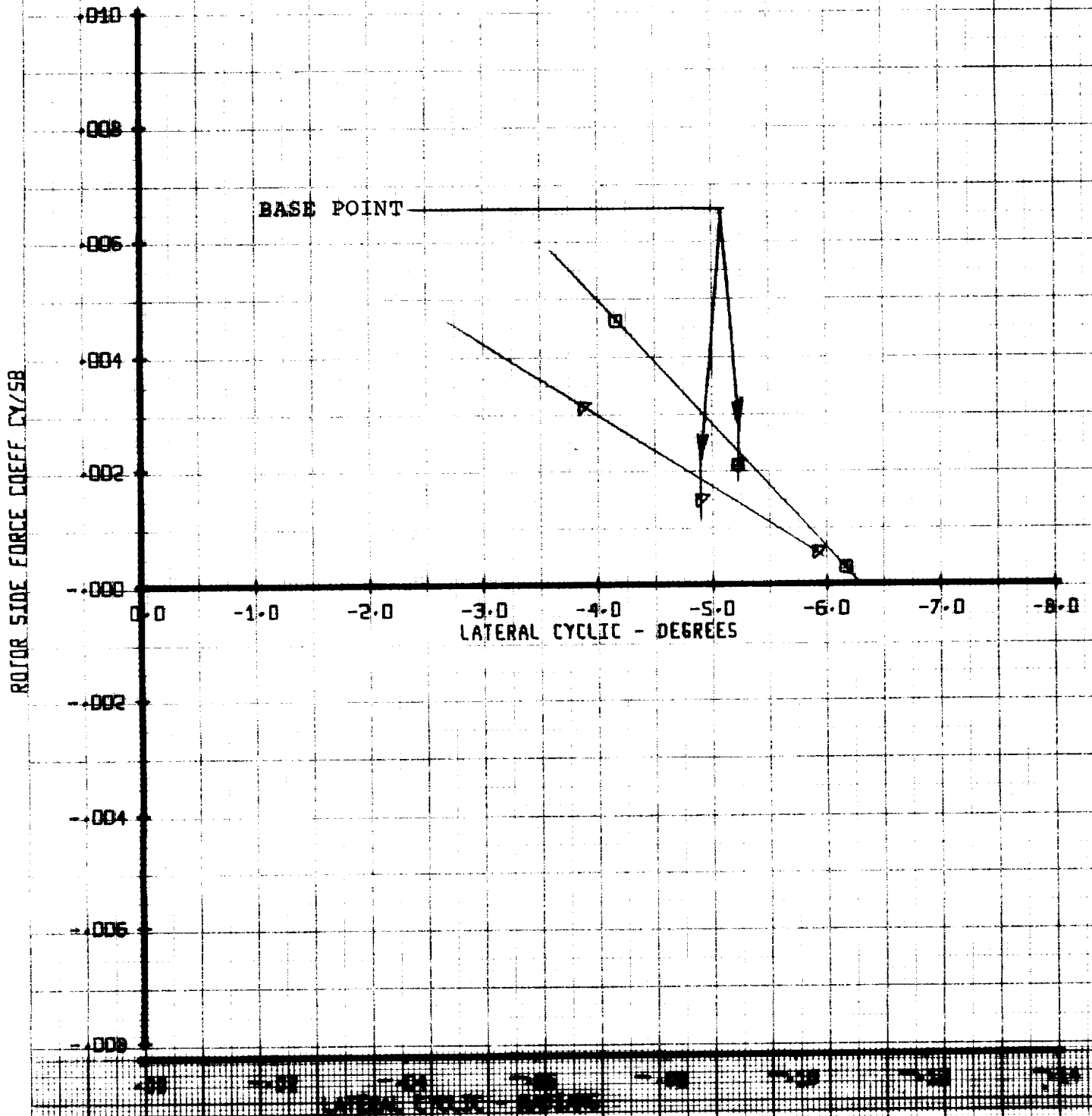


Figure C-174

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CI'/58	VTUN
□	41	.50	.10	.090	310
▽	41	.50	.10	.069	310

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

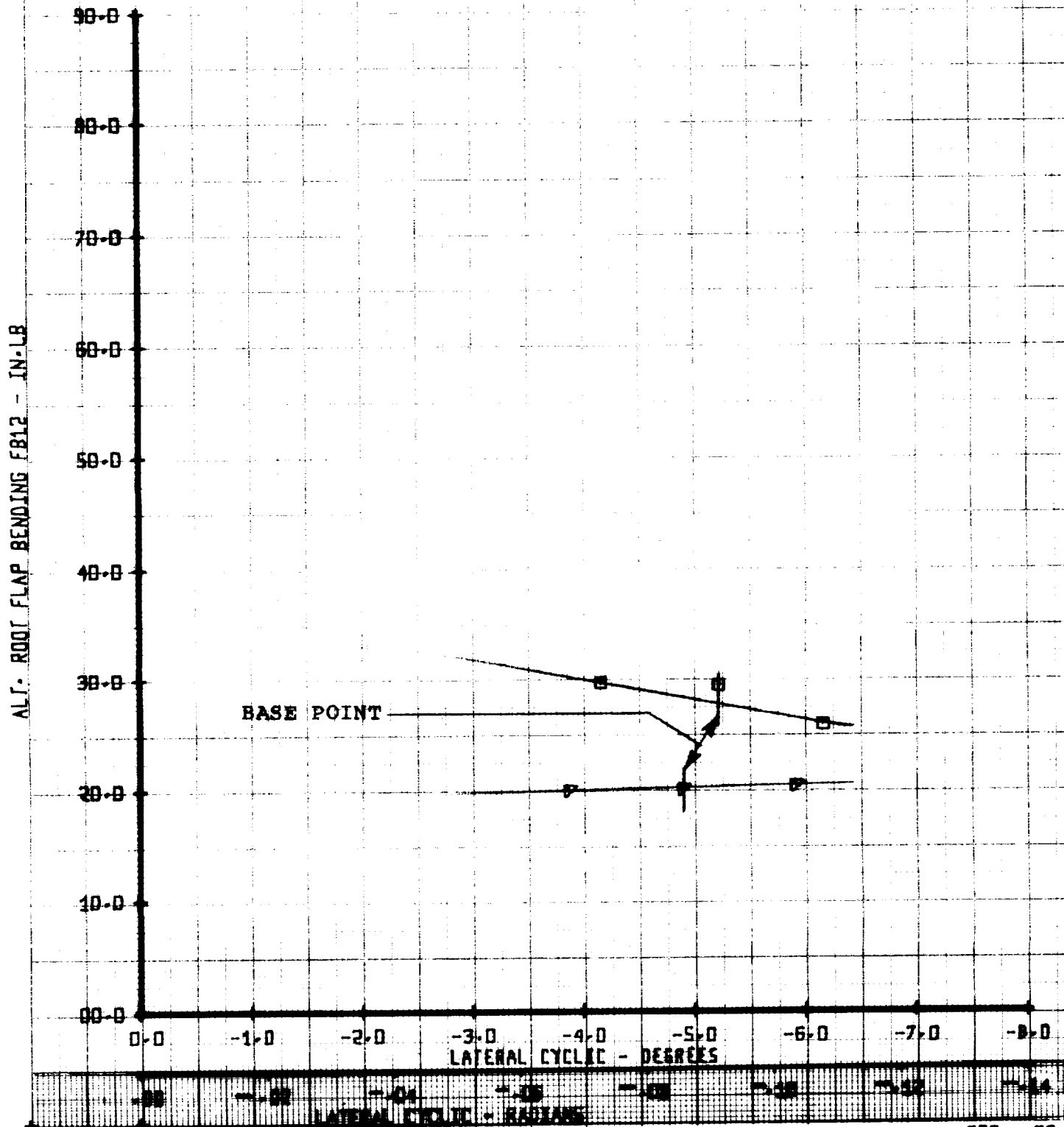


Figure C-175

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
□	42	.50	.02	.073	310
△	42	.50	.02	.059	310

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC

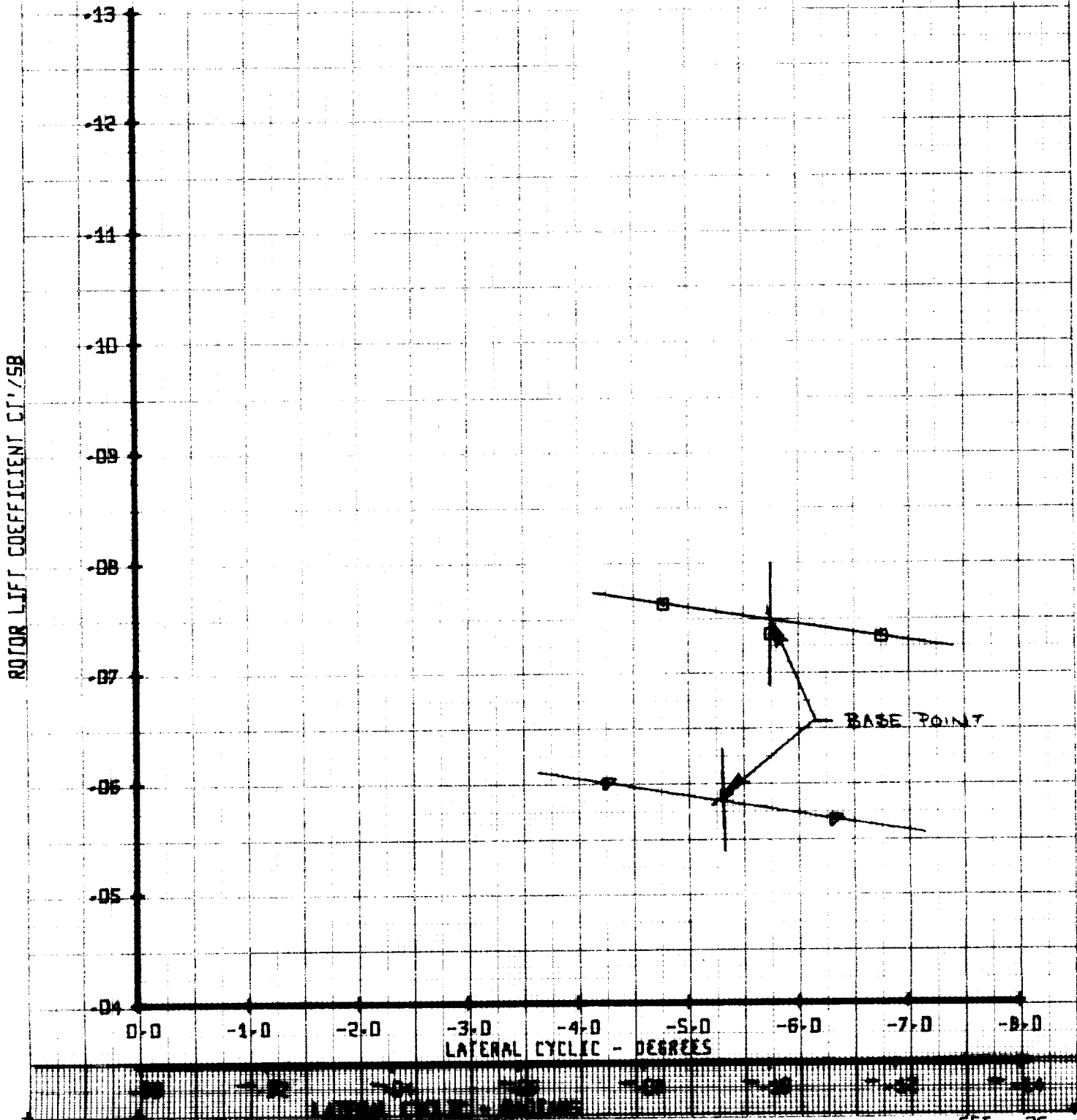


Figure C-176

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/58	VTUN
□	42	.50	.02	.073	310
△	42	.50	.02	.059	310

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LATERAL CYCLIC

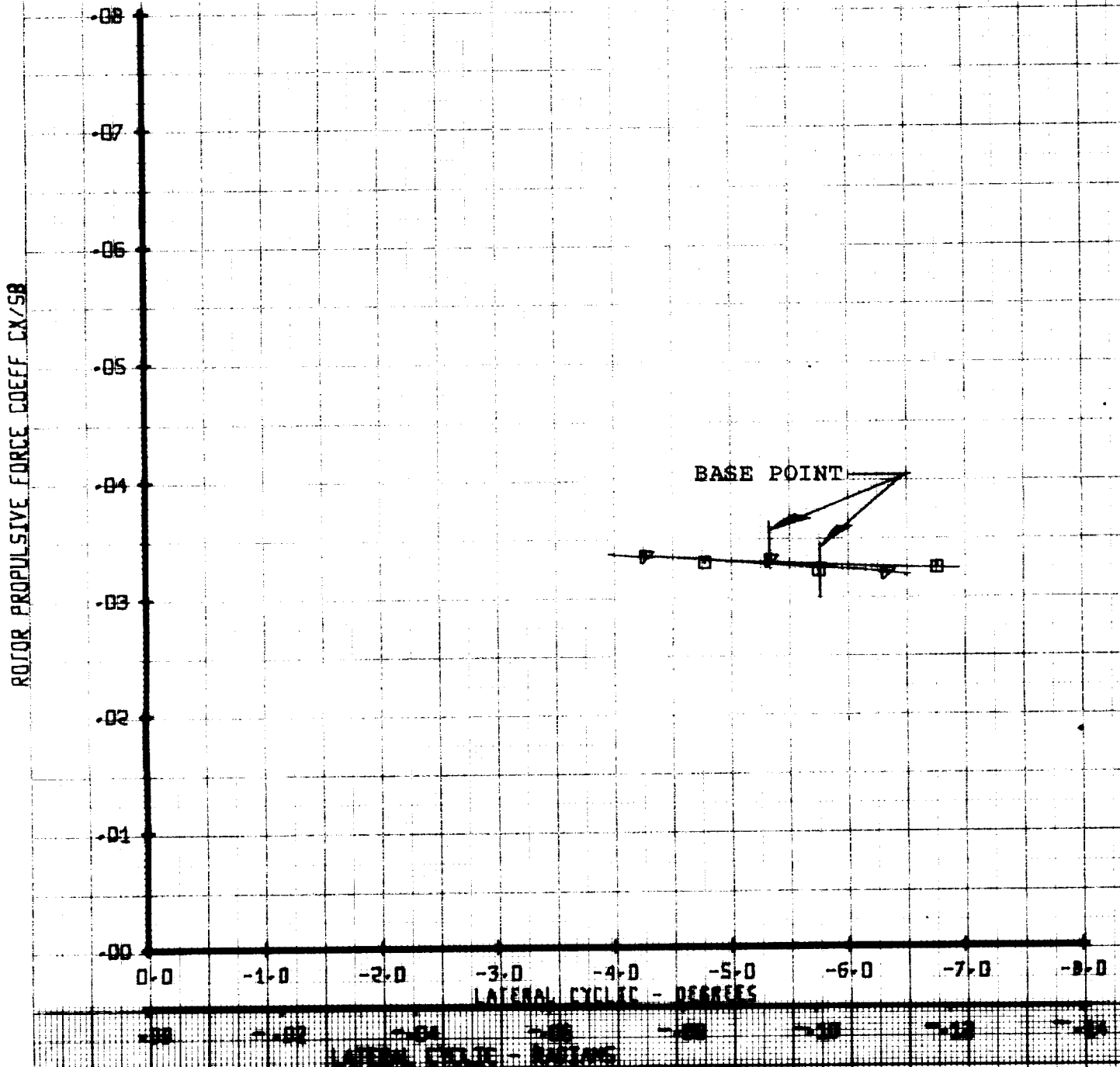


Figure C-177

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML	X/00258	CT/58	VTUN
□	42	.50	.02	.073	310
▣	42	.50	.02	.059	310

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

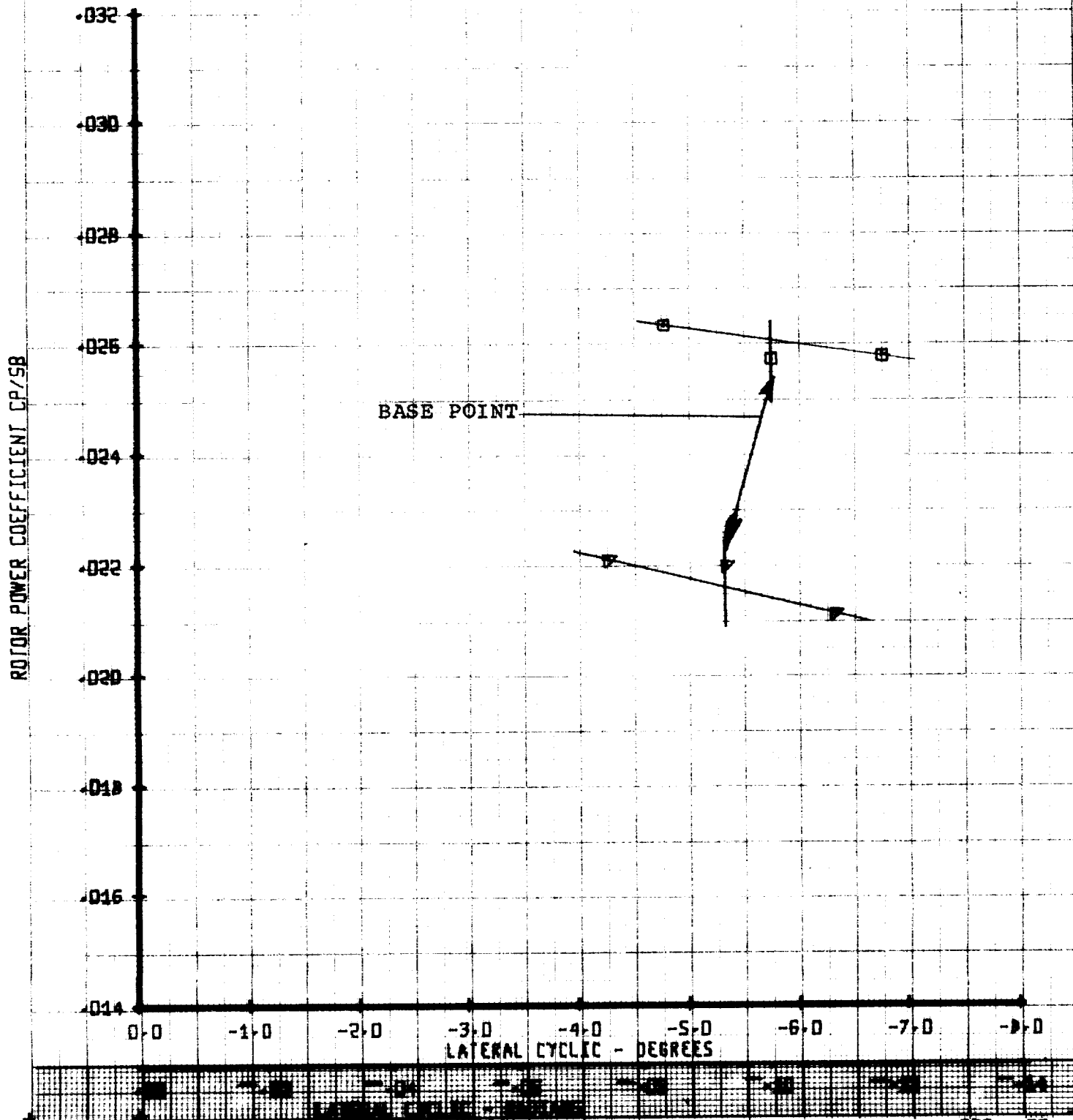


Figure C-178

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'1/58	VTUN
□	42	.50	.02	.073	310
▴	42	.50	.02	.059	310

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

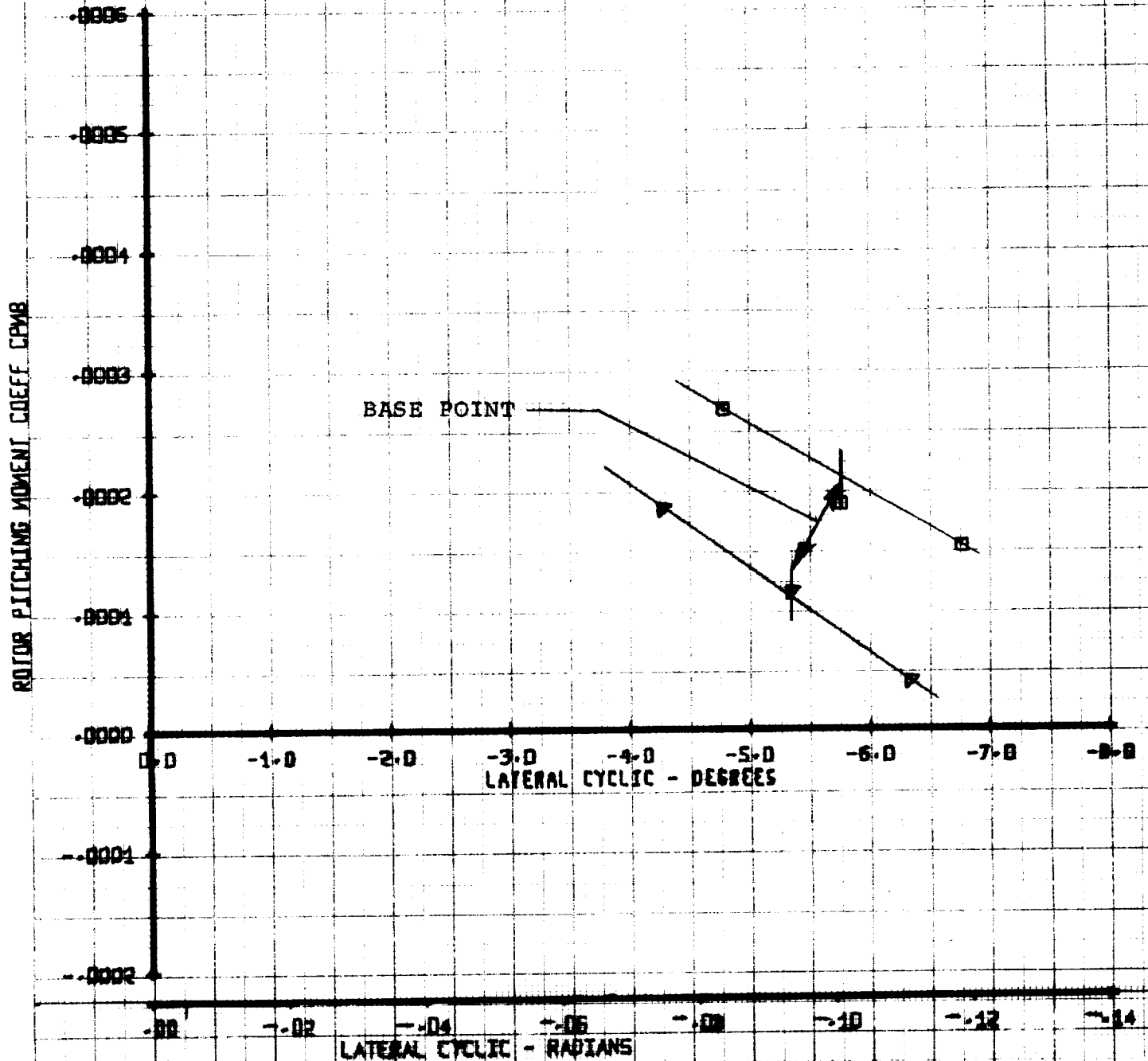


Figure C-179

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT/5B	VTUN
□	42	.50	.02	.073	310
▽	42	.50	.02	.059	310

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

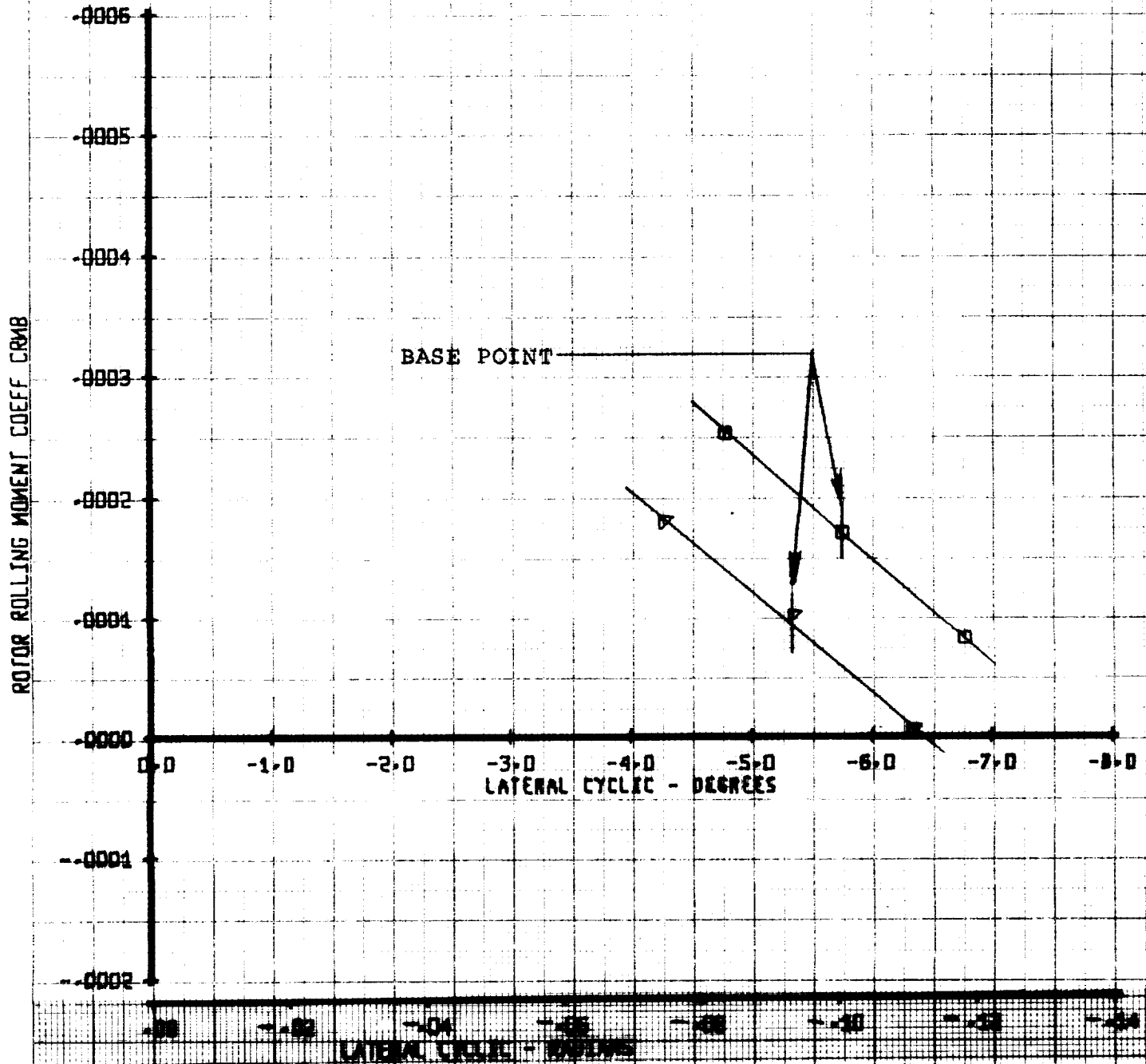


Figure C-180

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/0025B	CT'/SB	VTUN
0	42	.50	.02	.073	310
7	42	.50	.02	.059	310

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

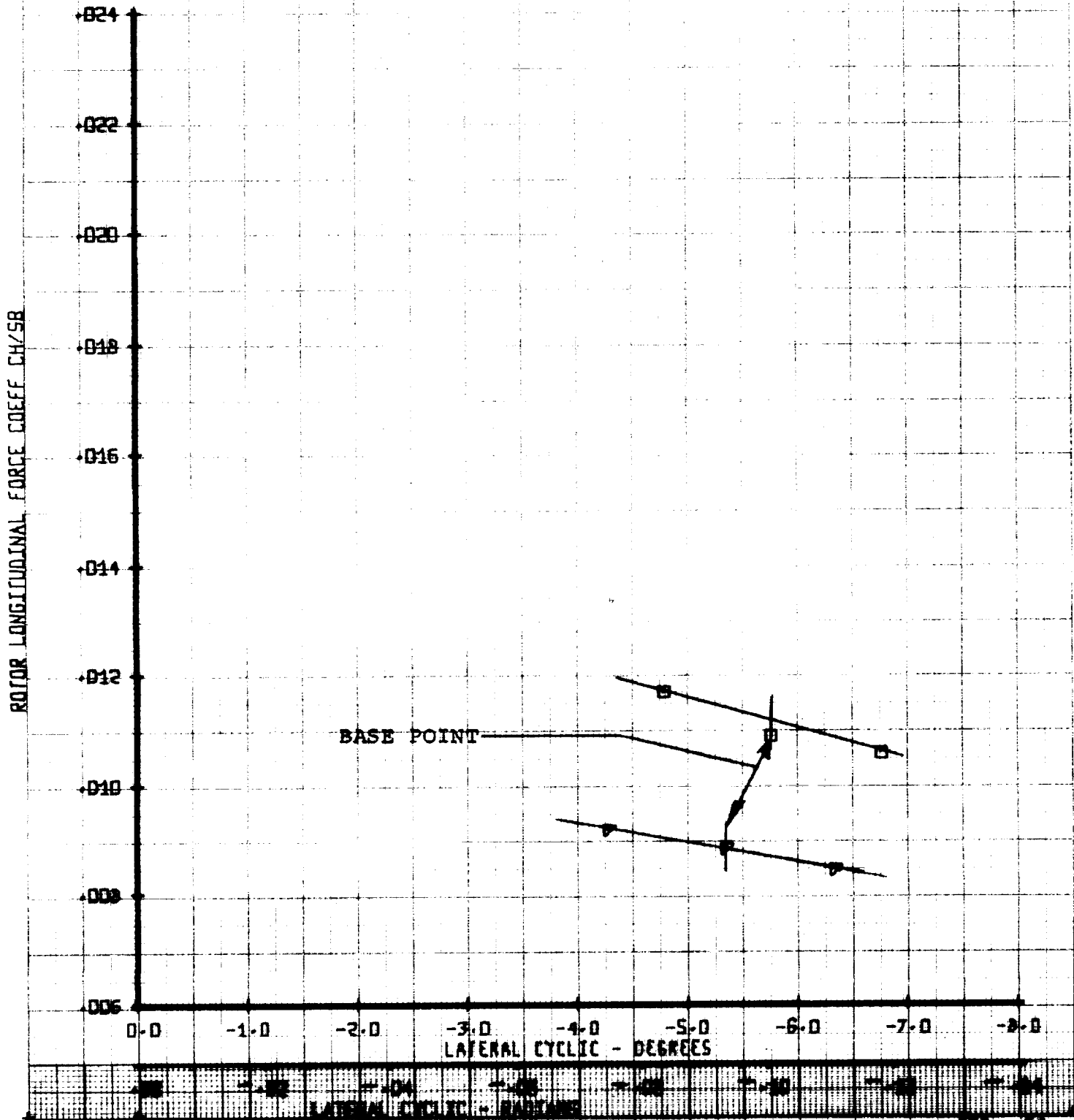


Figure C-181

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CI'/SB	YIUN
□	42	.50	.02	.073	310
△	42	.50	.02	.059	310

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

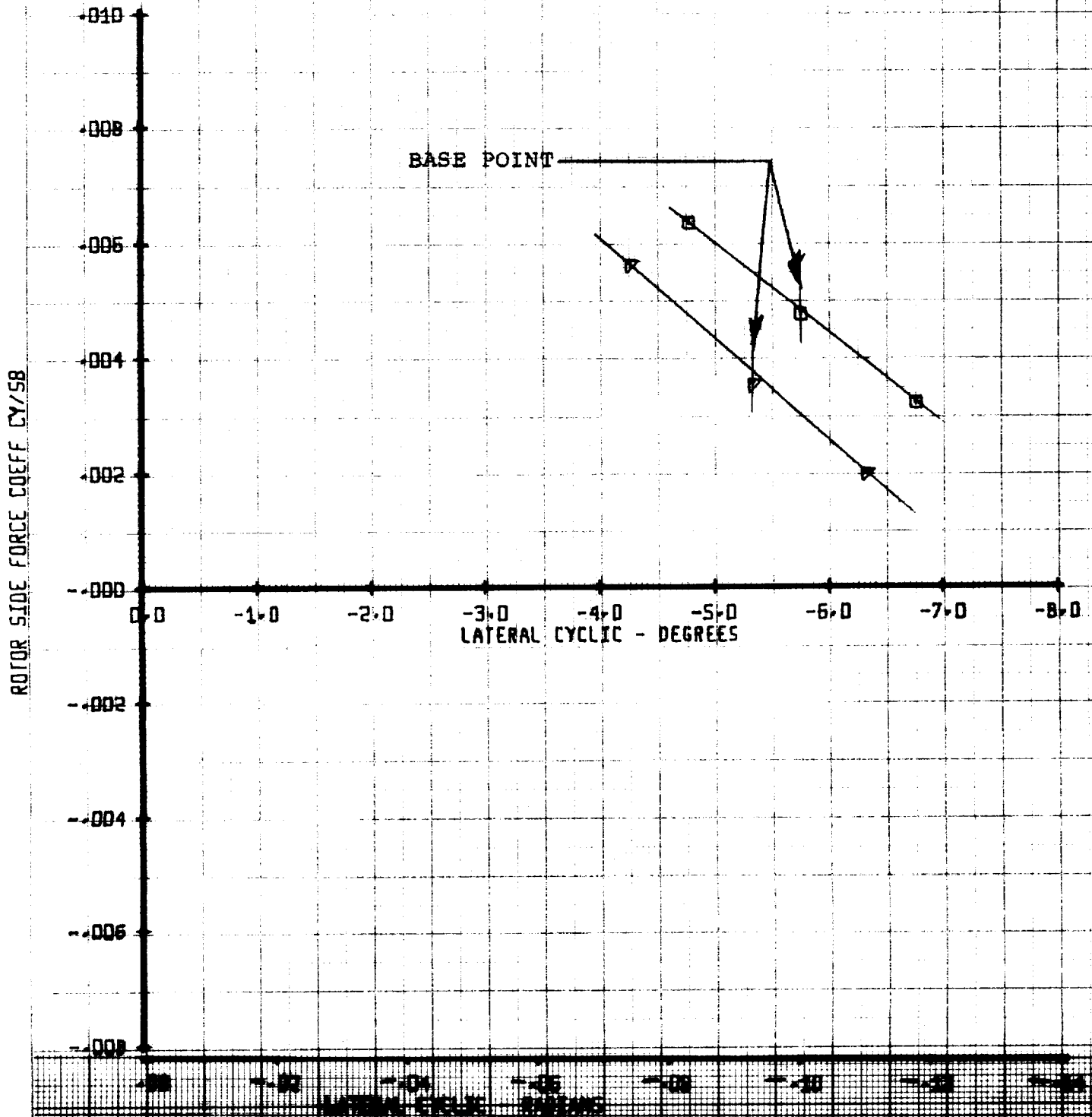


Figure C-182

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
□	42	.50	.02	.073	310
▽	42	.50	.02	.059	310

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

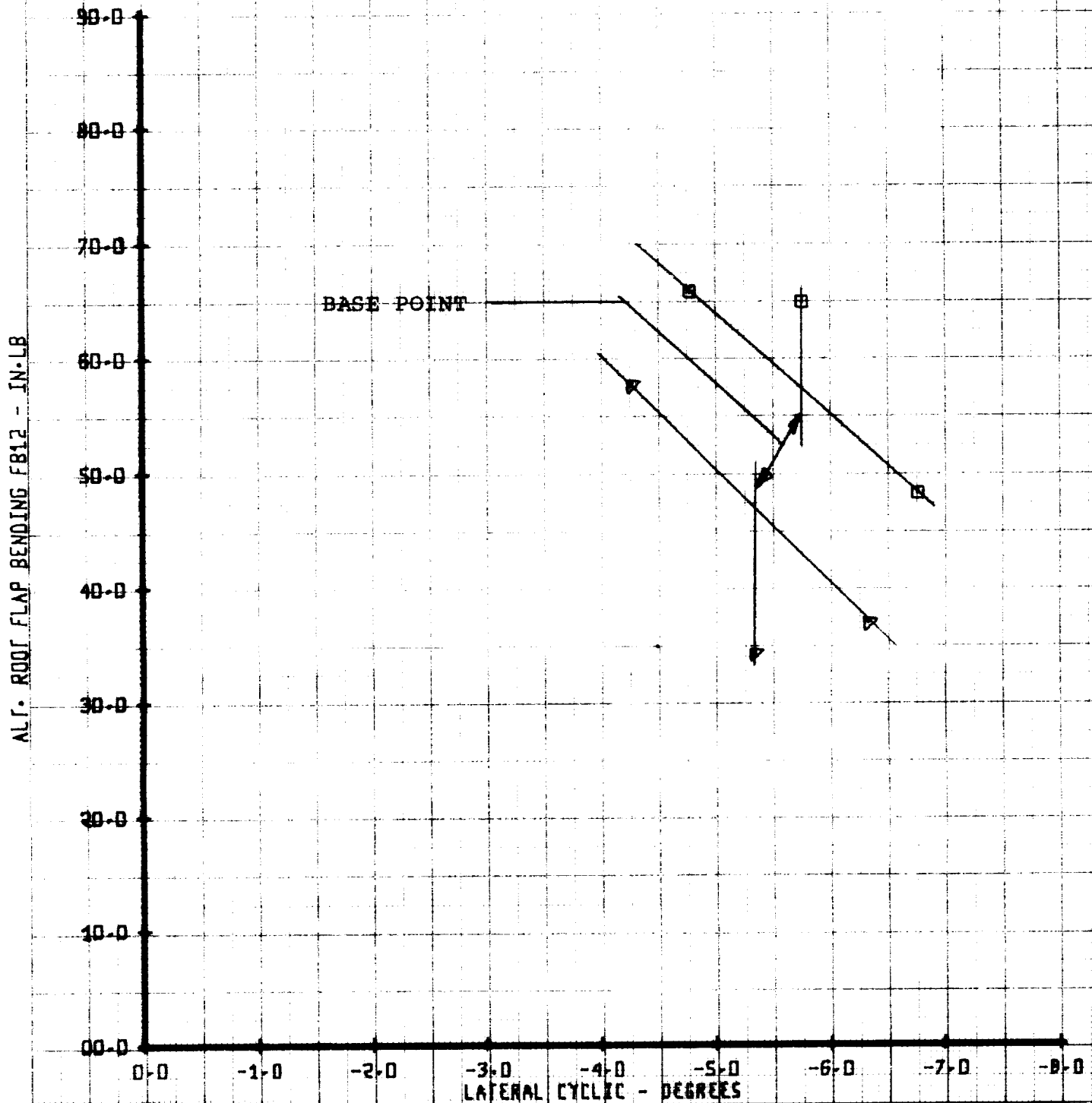


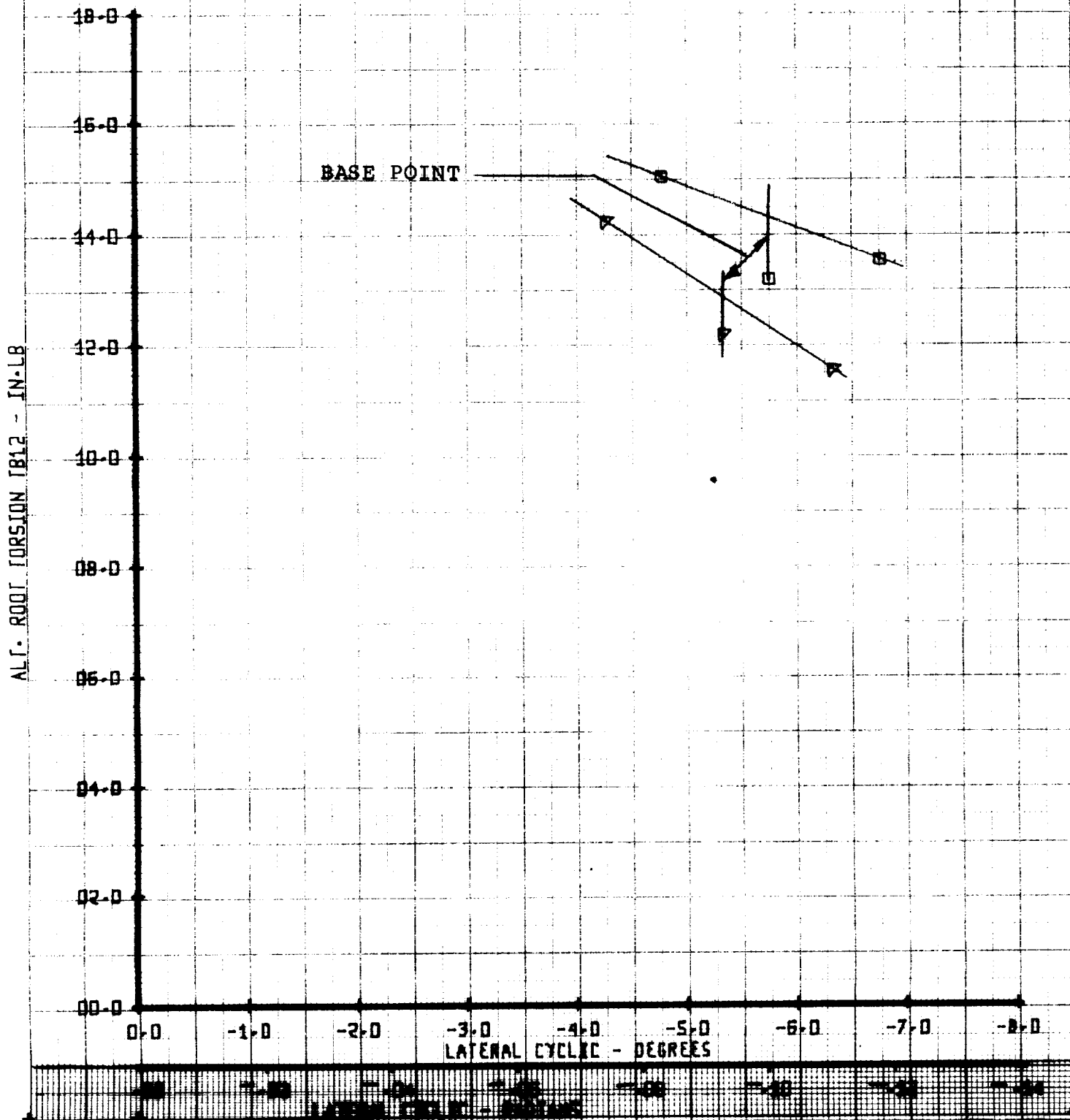
Figure C-183

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/00298	CT/SB	VTUN
□	42	.50	.02	.073	310
▽	42	.50	.02	.059	310

ALTERNATING ROOT TORSION TB12
VERSUS
LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST

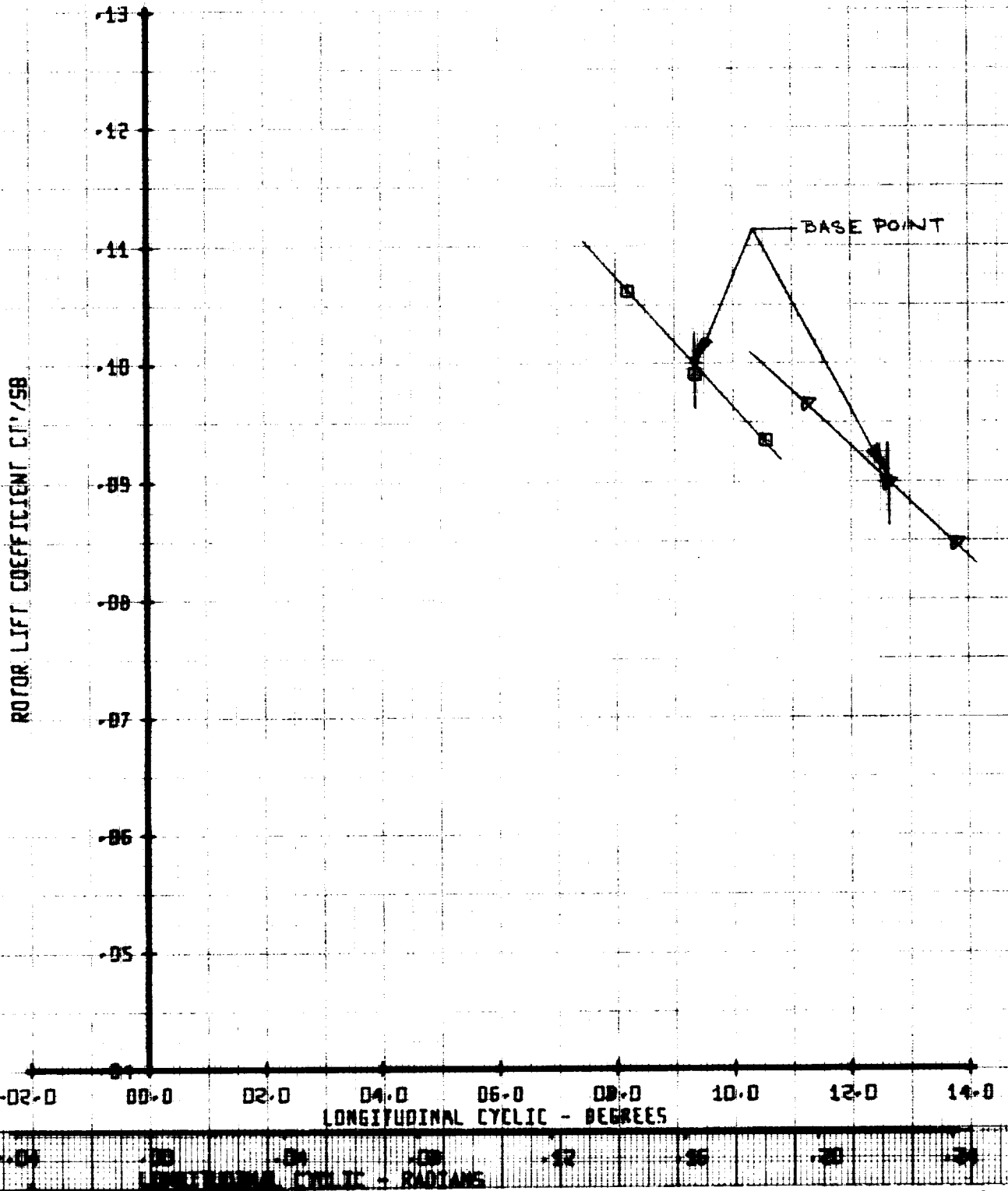
1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	YTUN
□	39	.50	.05	.098	310
△	41	.50	.10	.090	310

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



LEFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	39	.50	.05	.098	310
●	41	.50	.10	.090	310

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

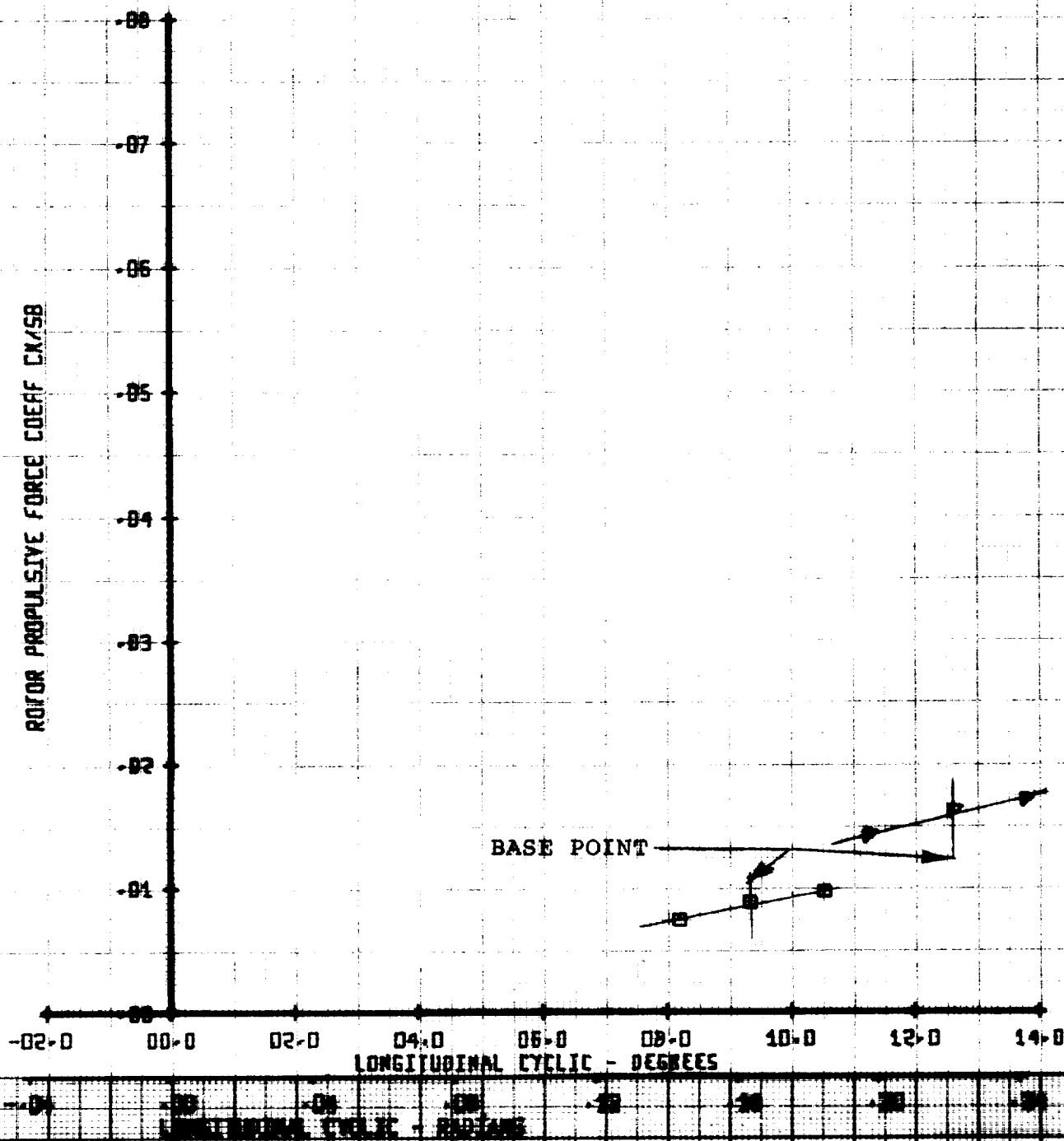


Figure C-186

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
0	39	.50	.05	.098	310
Δ	41	.50	.10	.090	310

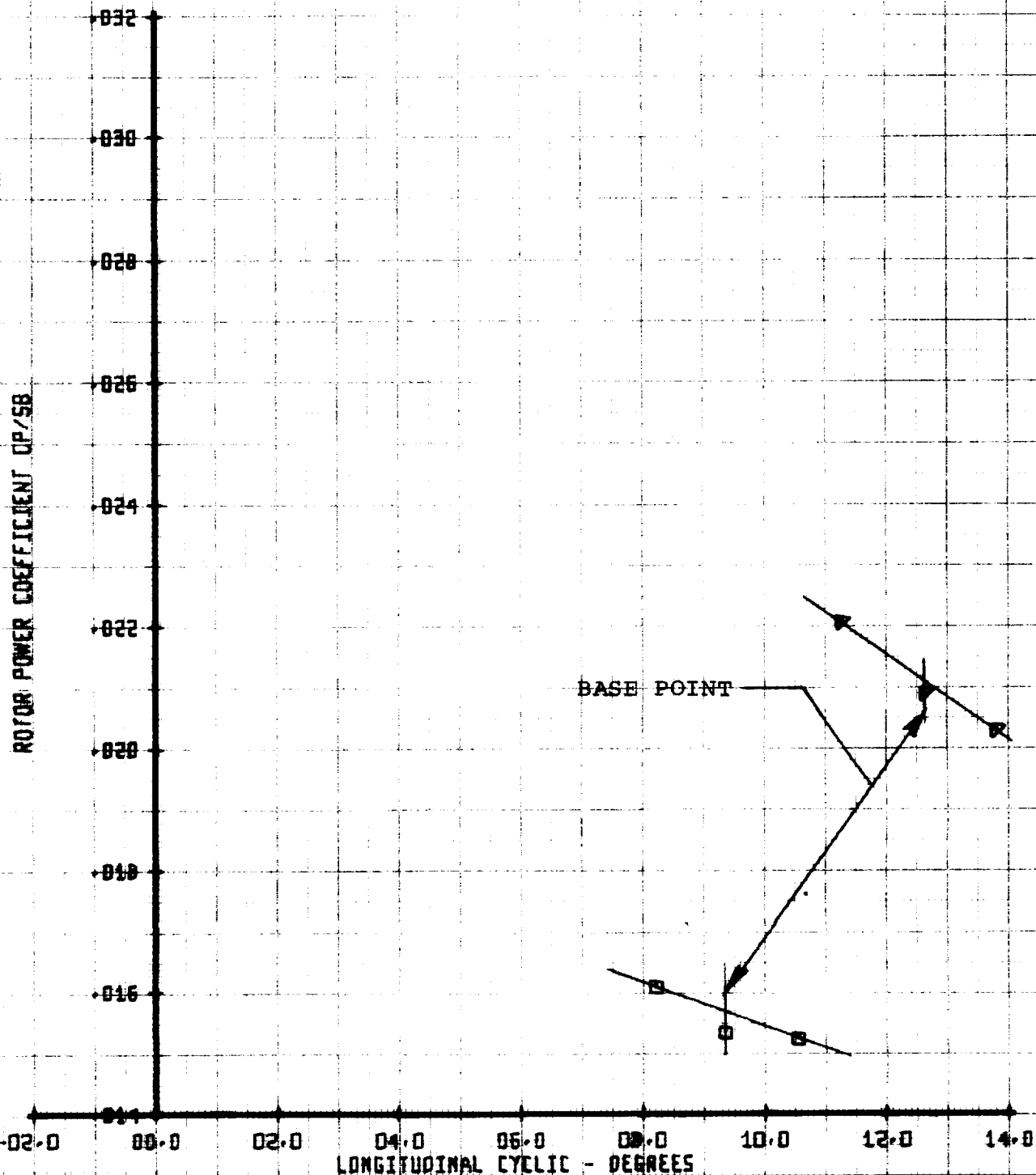
 ROTOR POWER COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC


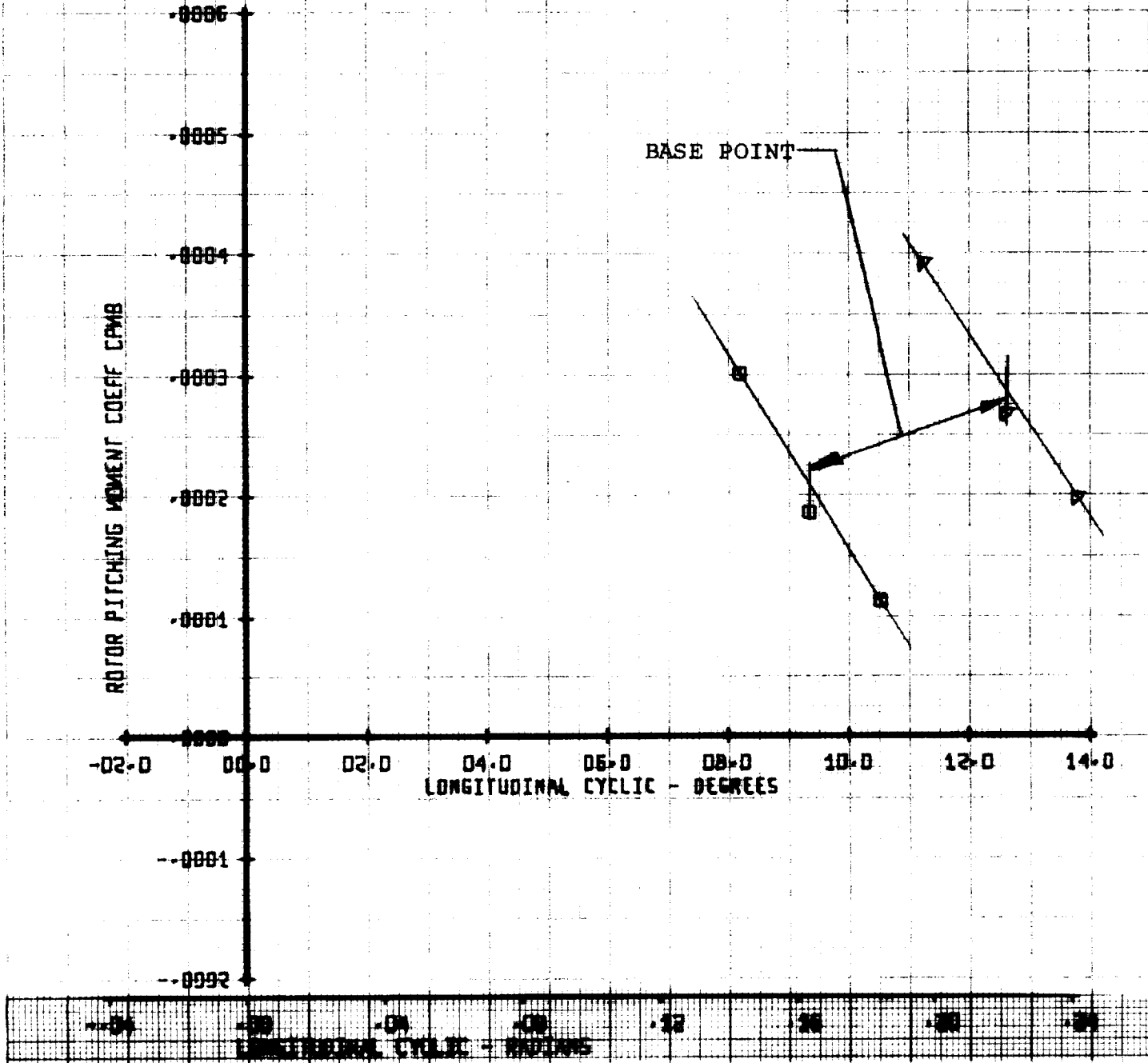
Figure C-187

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SAM	RUN	MU	X/00258	CT/58	VTUN
0	39	.50	.05	.098	310
4	41	.50	.10	.090	310

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
□	39	.50	.05	.098	310
▽	41	.50	.10	.090	310

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

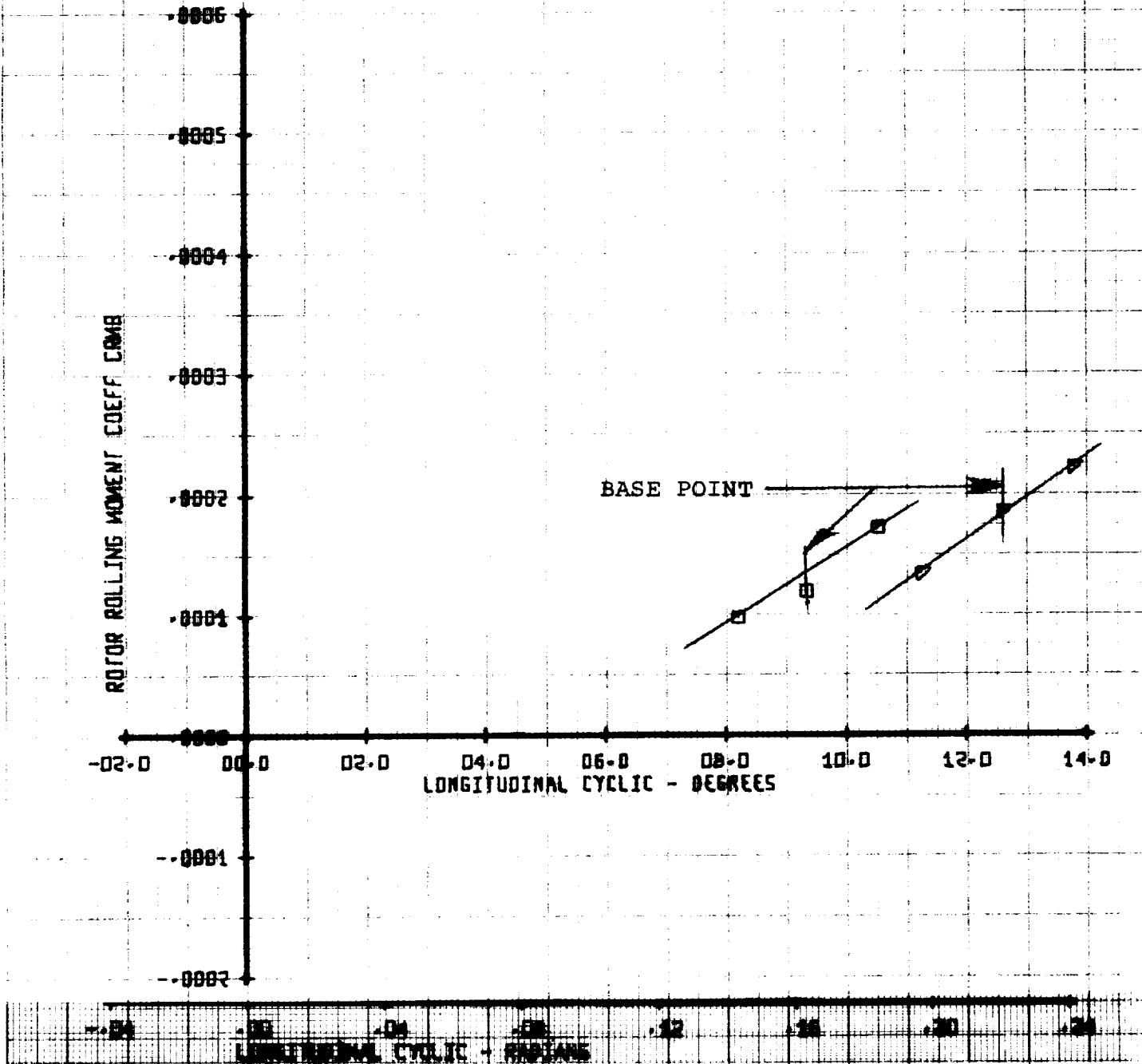


Figure C-189

LEFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DD25B	CT'/SB	VTUN
□	39	.50	.05	.098	310
▽	41	.50	.10	.090	310

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

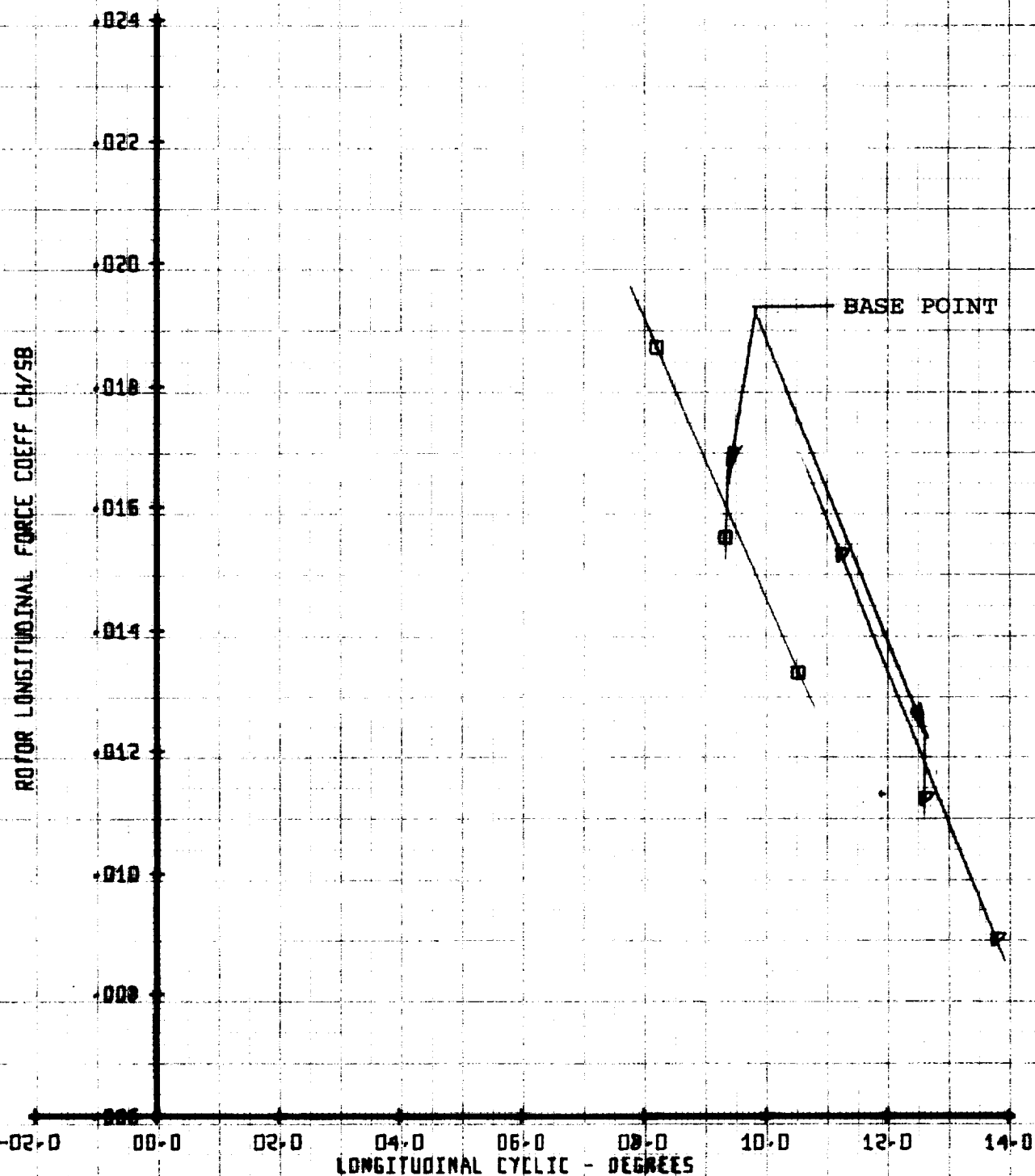


Figure C-190

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/58	VTUN
□	39	.50	.05	.098	310
▽	41	.50	.10	.090	310

ROTOR SIDE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

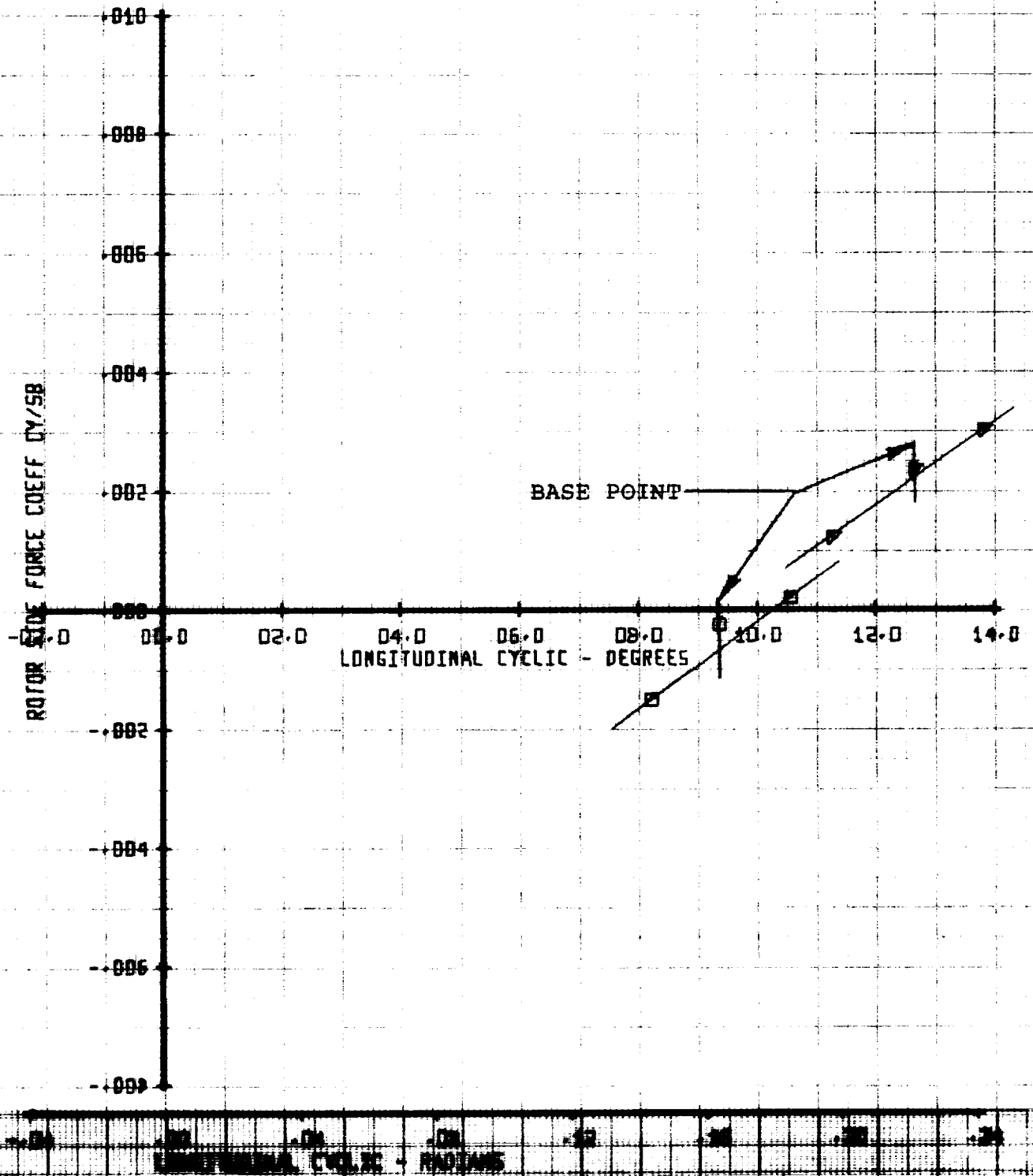


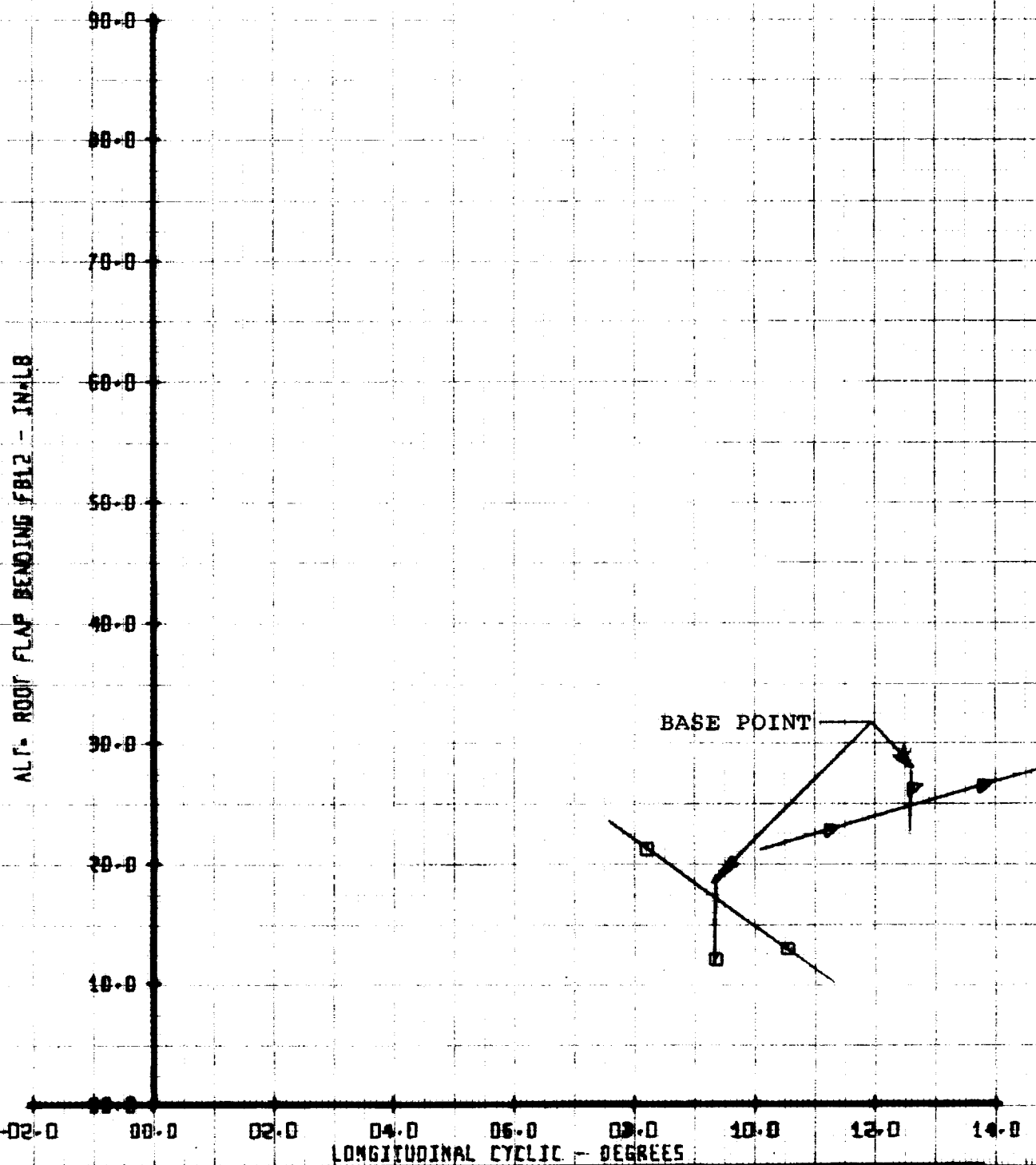
Figure C-191

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD258	CT/SB	VTUN
□	39	.50	.05	.098	310
▽	41	.50	.10	.090	310

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC



SET 27
BVWT 187

Figure C-192

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	MIN	MAX	X/00256	CT/98	Y/LIN
0	30	.50	.07	.308	310
1	41	.70	.10	.300	310

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC

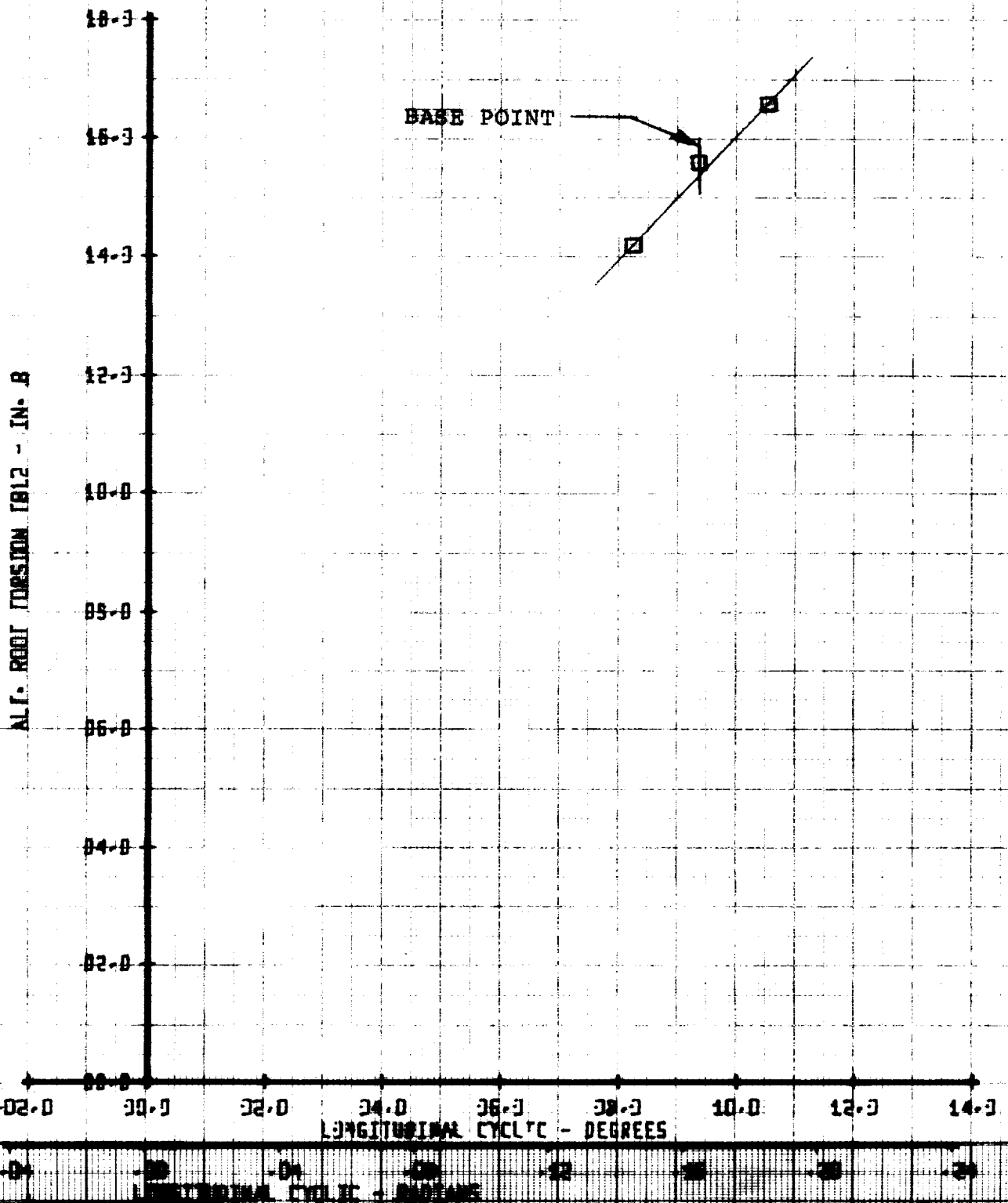


Figure C-193

LIFT-PROPULSIVE FORCE LIMIT TEST
1/30 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/00250	CT/50	VTUN
0	39	.50	.05	.078	310
7	41	.50	.10	.069	310
8	42	.50	.20	.059	310

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

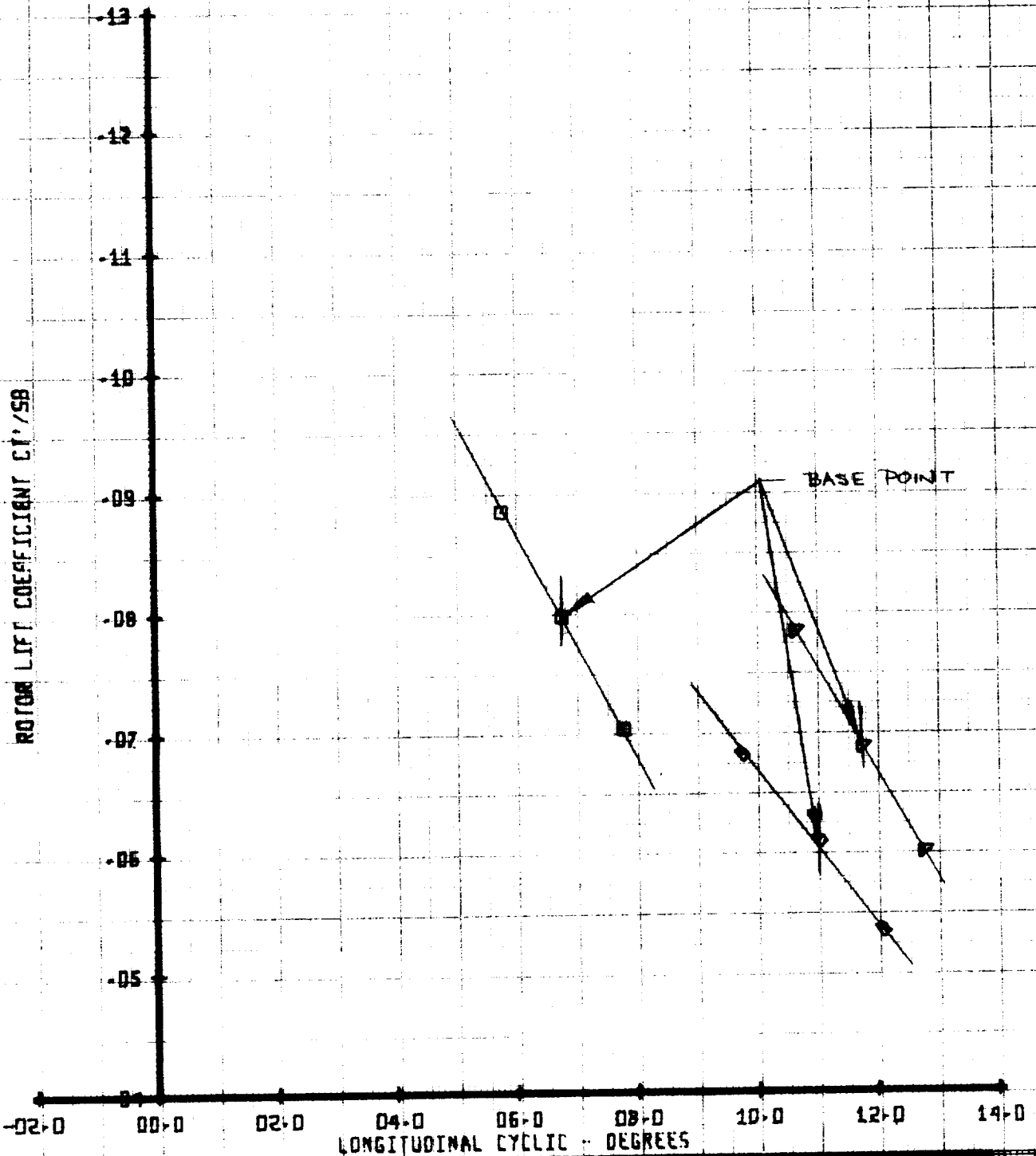


Figure C-194

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT'/SB	VTUN
0	39	.50	.05	.078	310
1	41	.50	.10	.069	310
2	42	.50	.20	.059	310

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

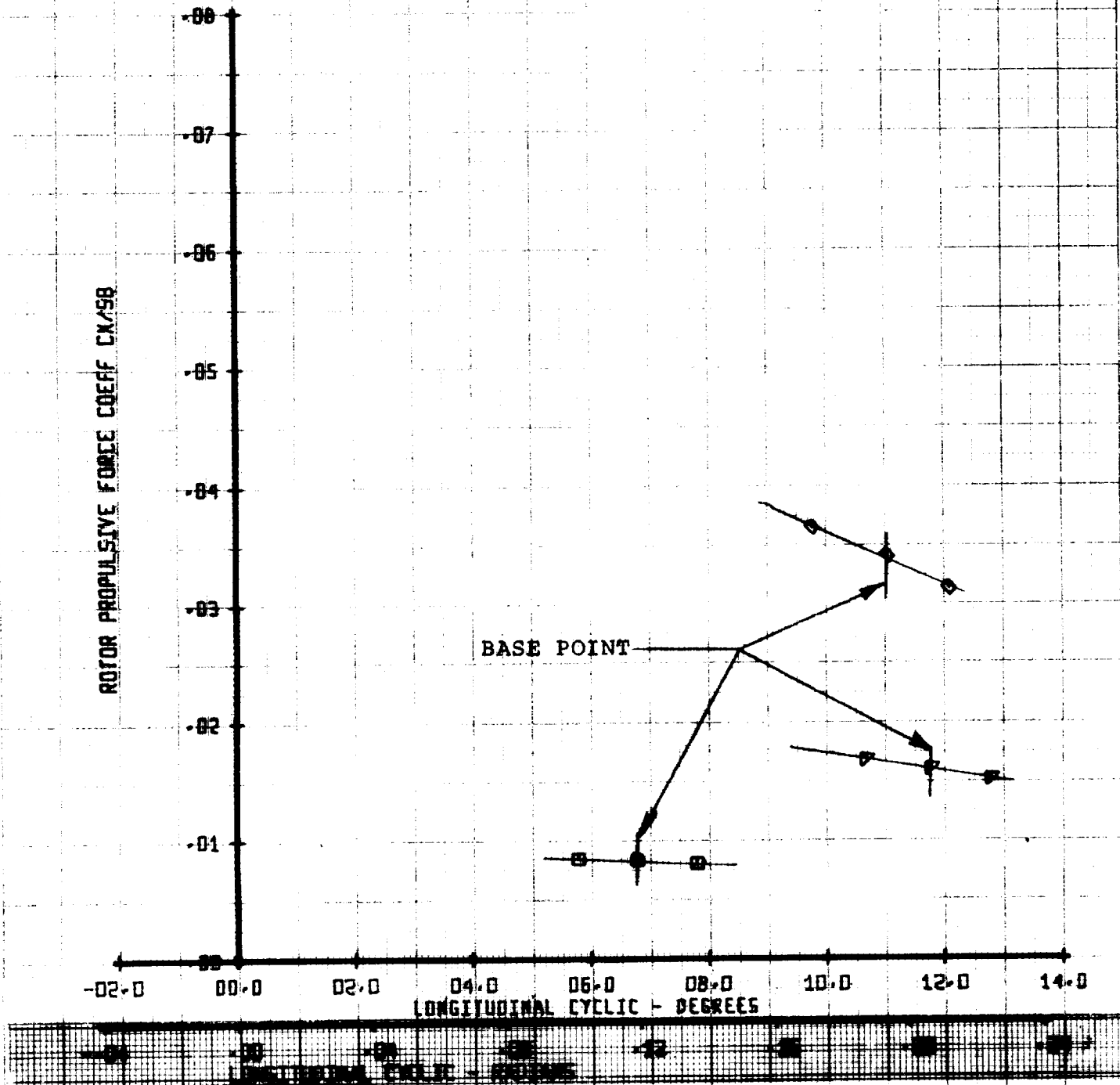


Figure C-195

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND					
SYM	RUN	MU	X/00258	CI/58	VTUN
□	39	.50	.05	.079	310
△	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

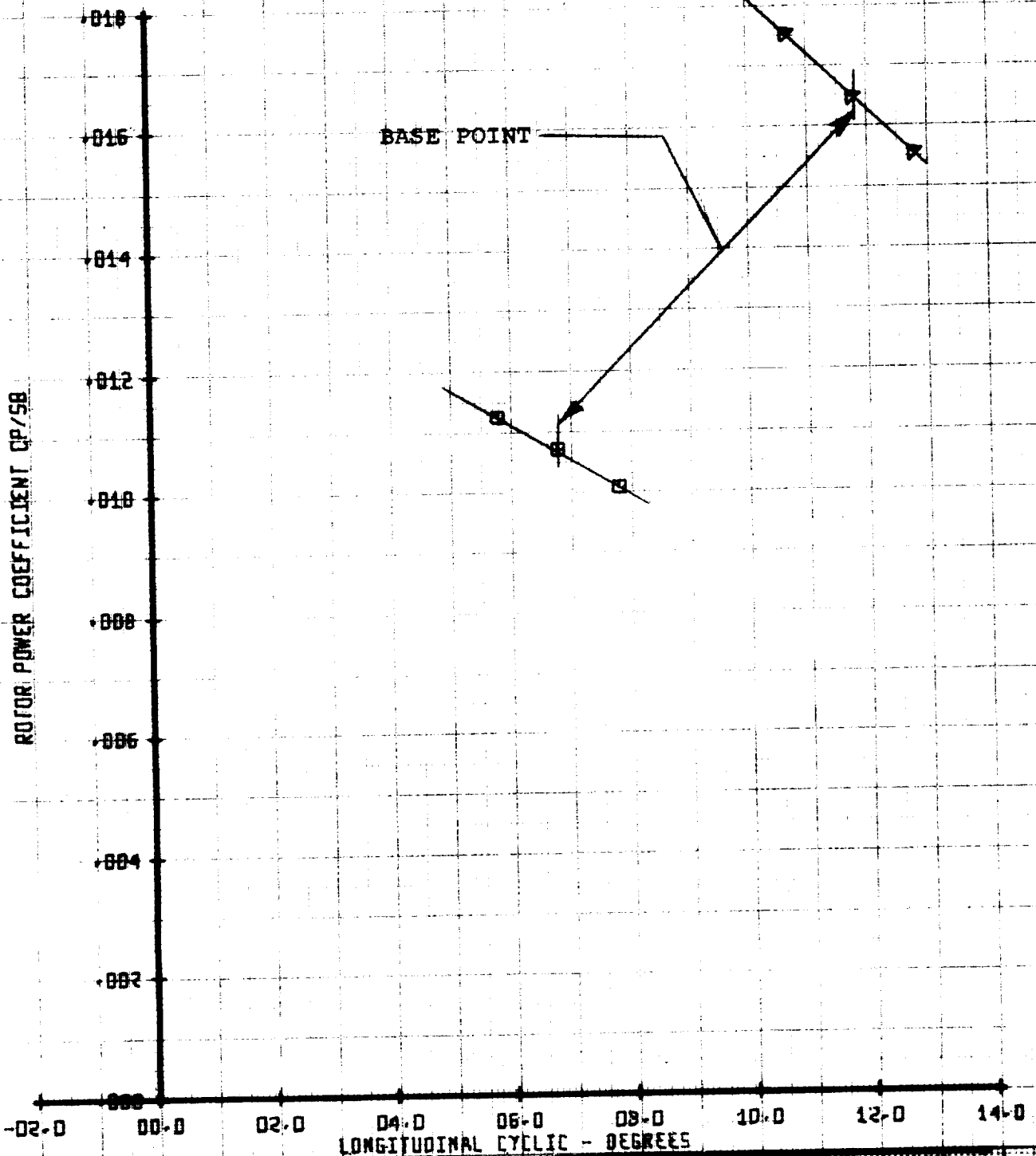


Figure C-196

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND					
SYM	RUN	MU	X/DD2SB	CT/5B	VTUN
◇	39	.50	.05	.078	310
	41	.50	.10	.069	310
	42	.50	.20	.059	310

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

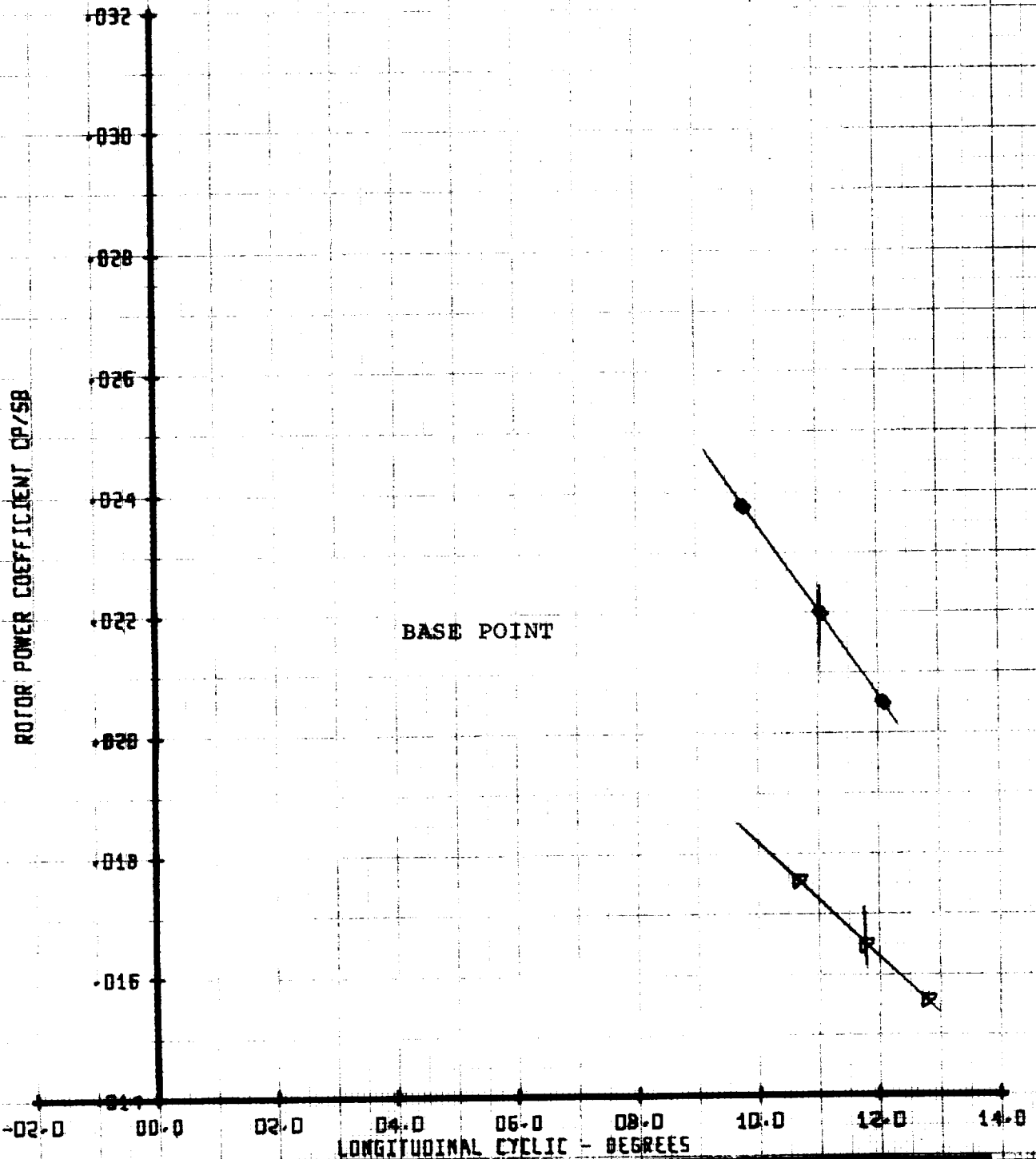


Figure C-197

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/OD258	CT/5B	VTUN
□	39	.50	.05	.078	310
△	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

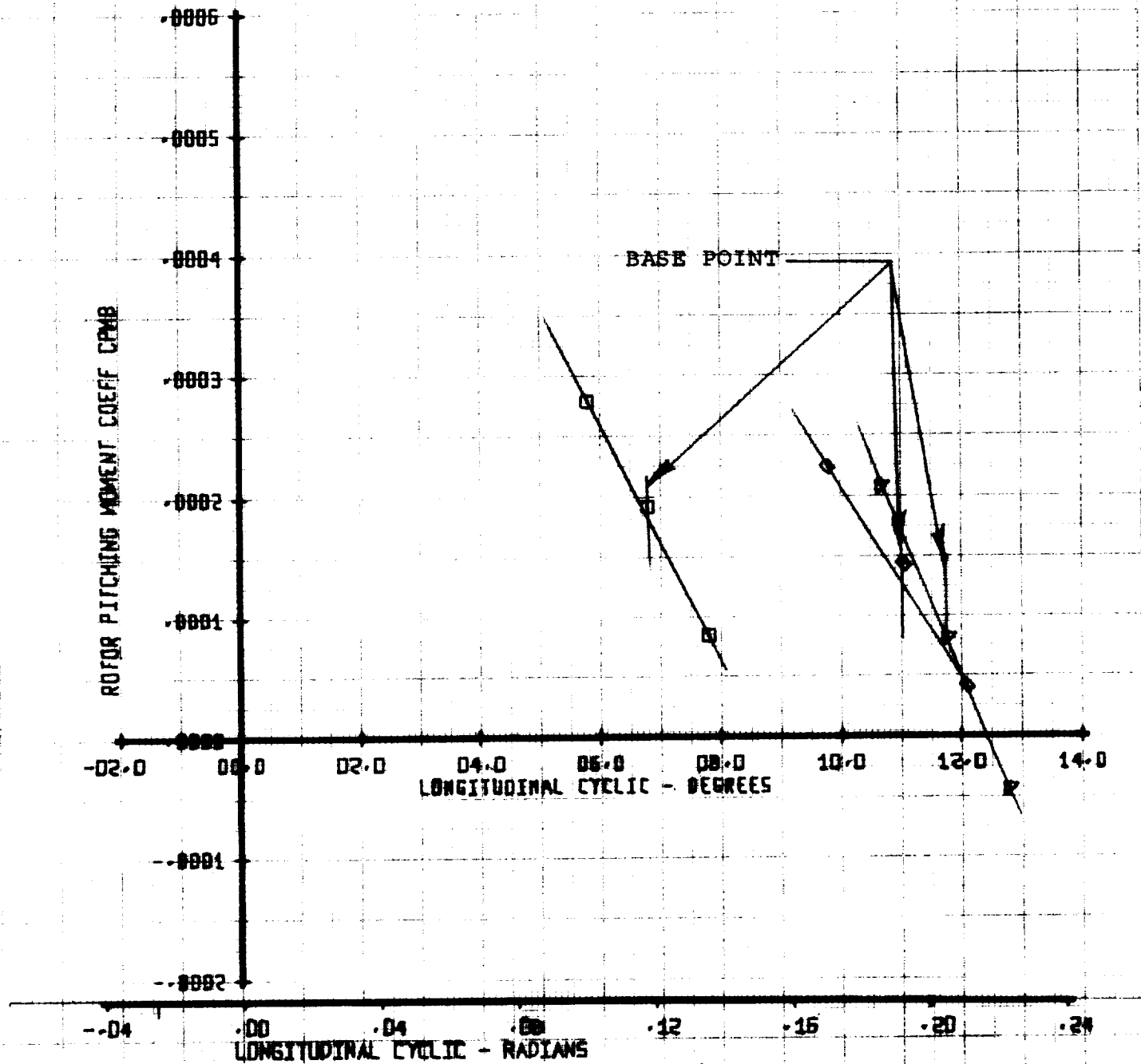


Figure C-198

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD2SB	CT1/SB	VTUN
□	39	.50	.05	.078	310
△	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

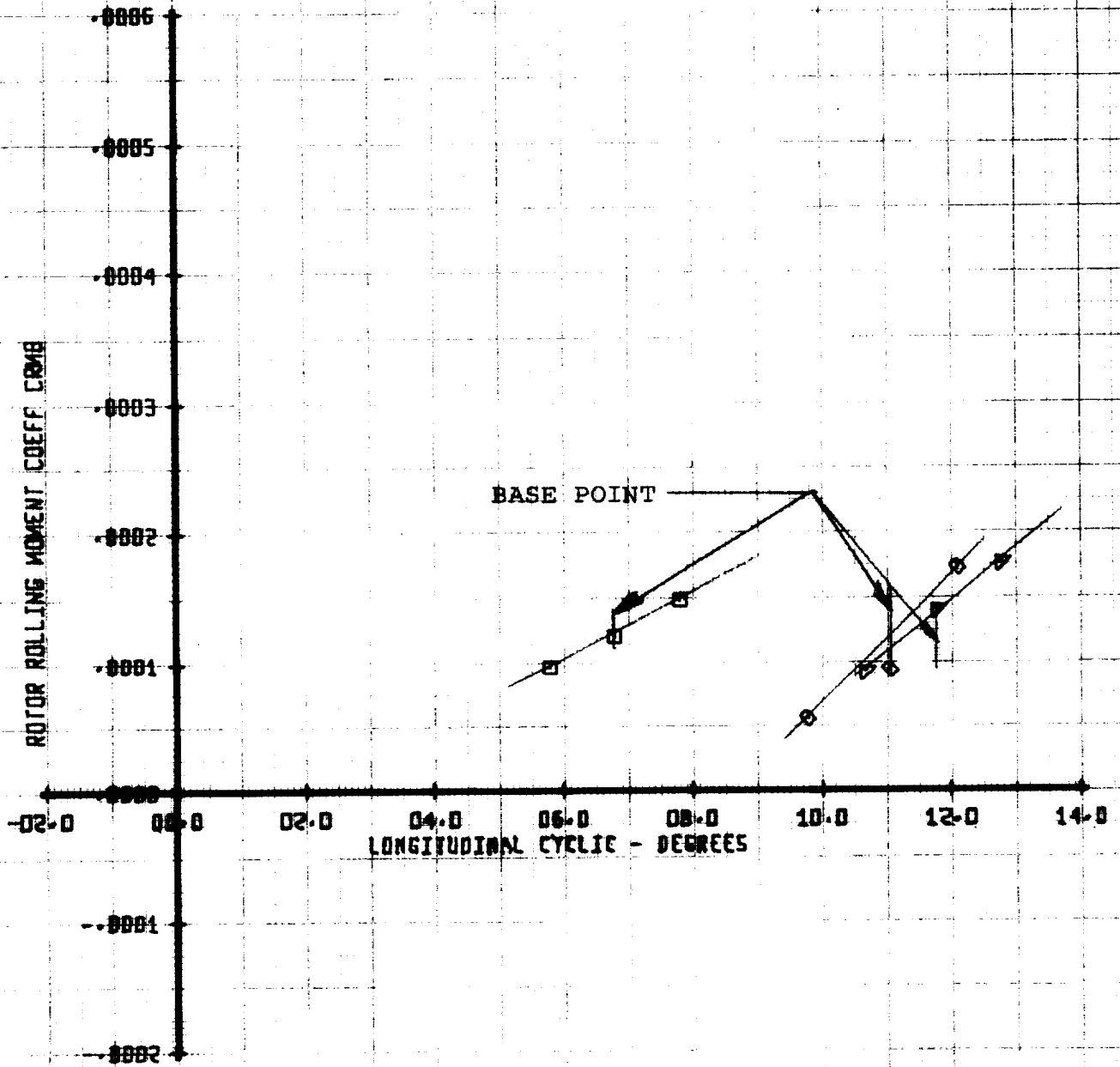


Figure C-199

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT/5B	VTUN
□	39	.50	.05	.078	310
△	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

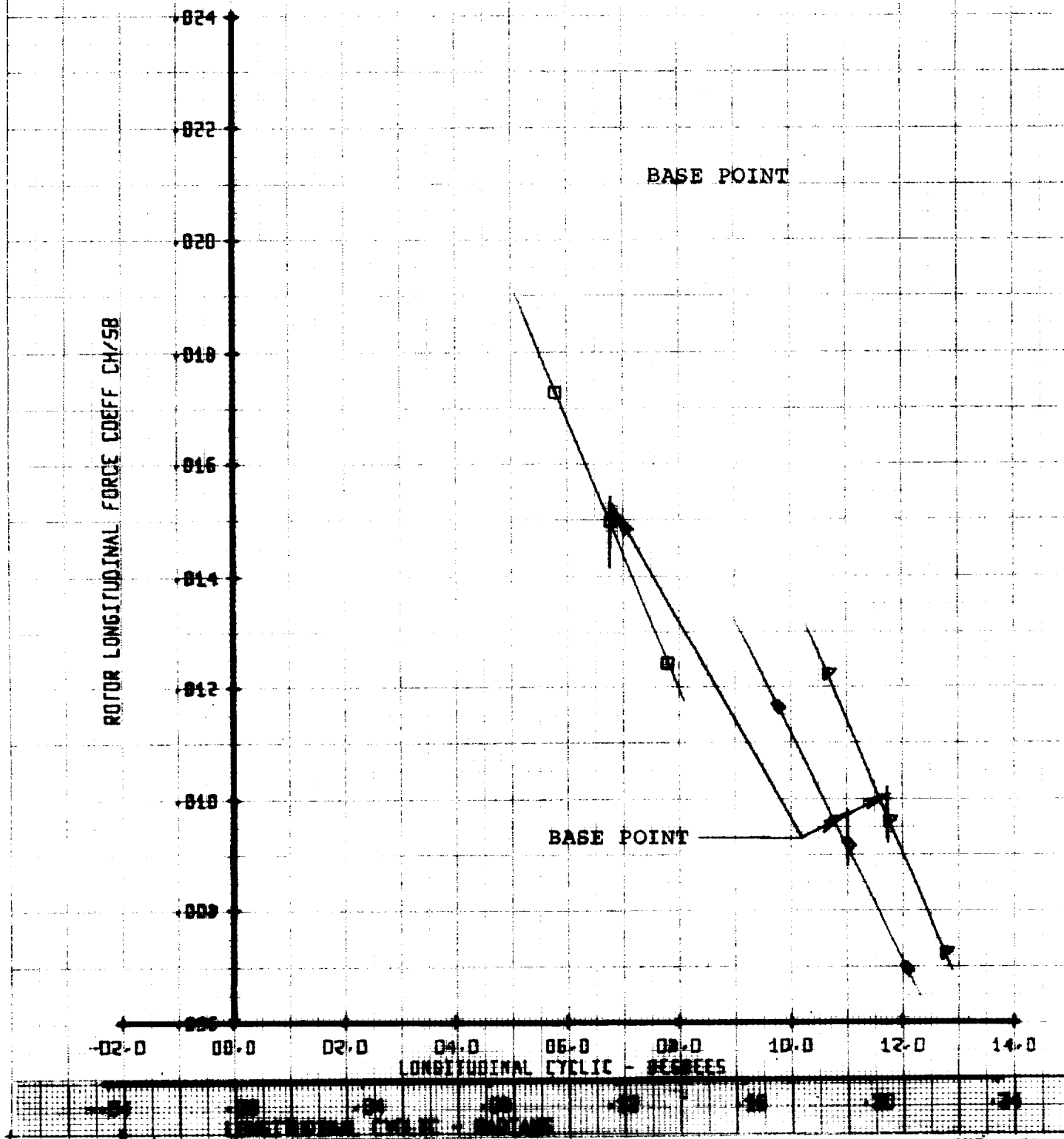


Figure C-200

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

SYM	RUN	MU	X/00258	CT/58	YTUN
△	39	.50	.05	.078	310
□	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

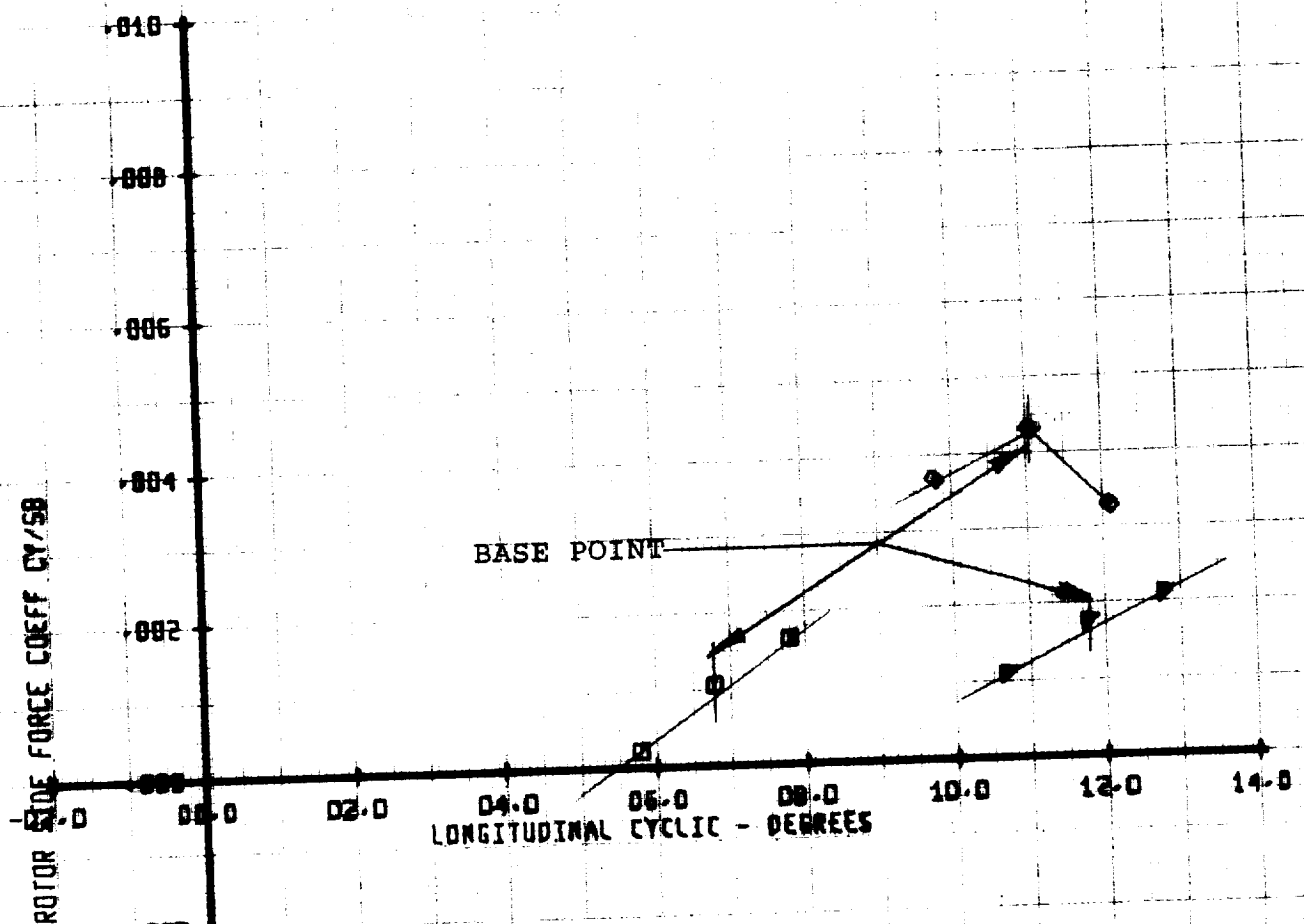


Figure C-201

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND					
SYM	RUN	MU	X/00258	CT/58	VTUN
□	39	.50	.05	.078	310
▽	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC

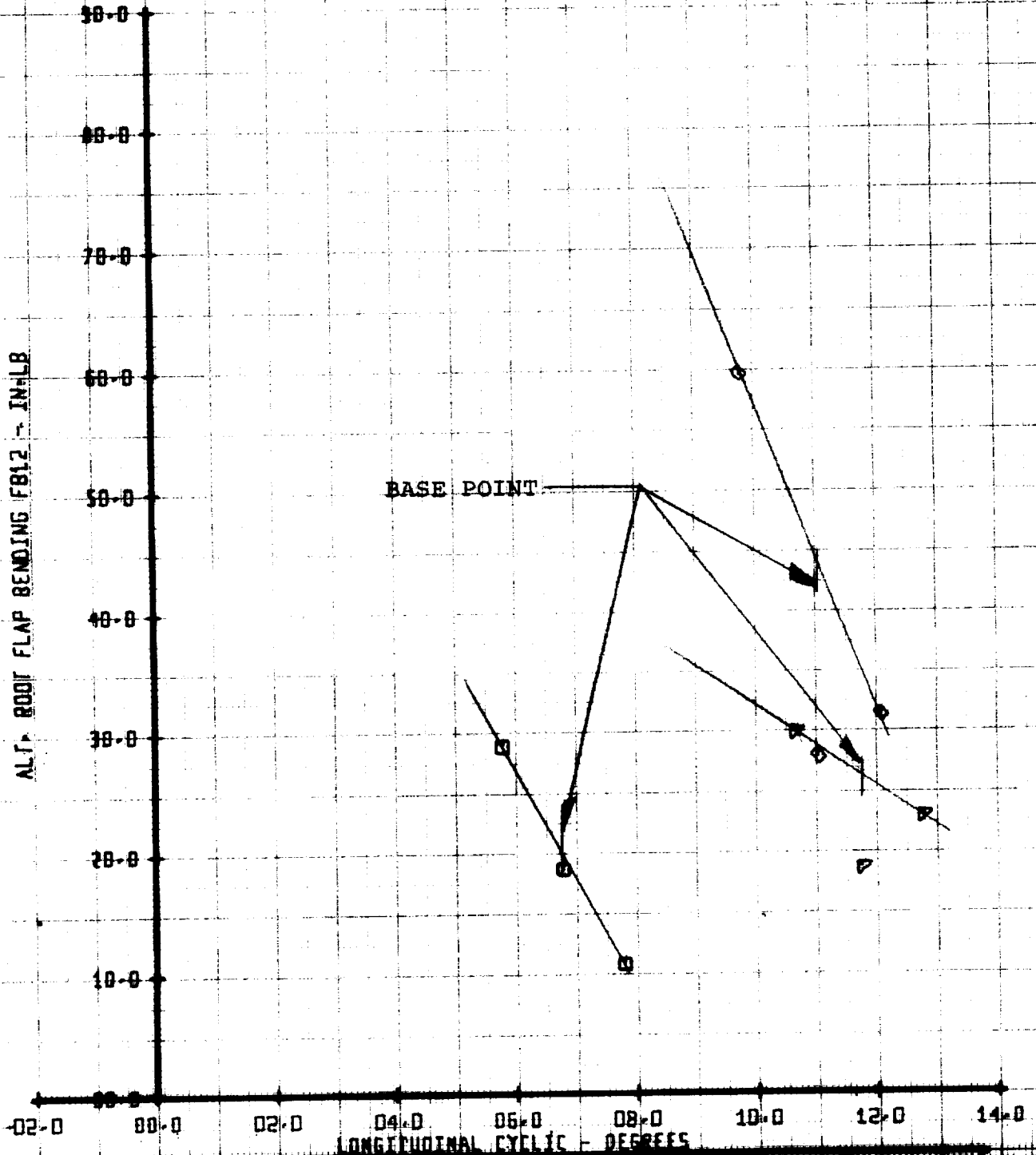


Figure C-202

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND					
SYM	RUN	MU	X/0025B	CT/5B	VTUN
□	39	.50	.05	.078	310
▽	41	.50	.10	.069	310
◇	42	.50	.20	.059	310

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC

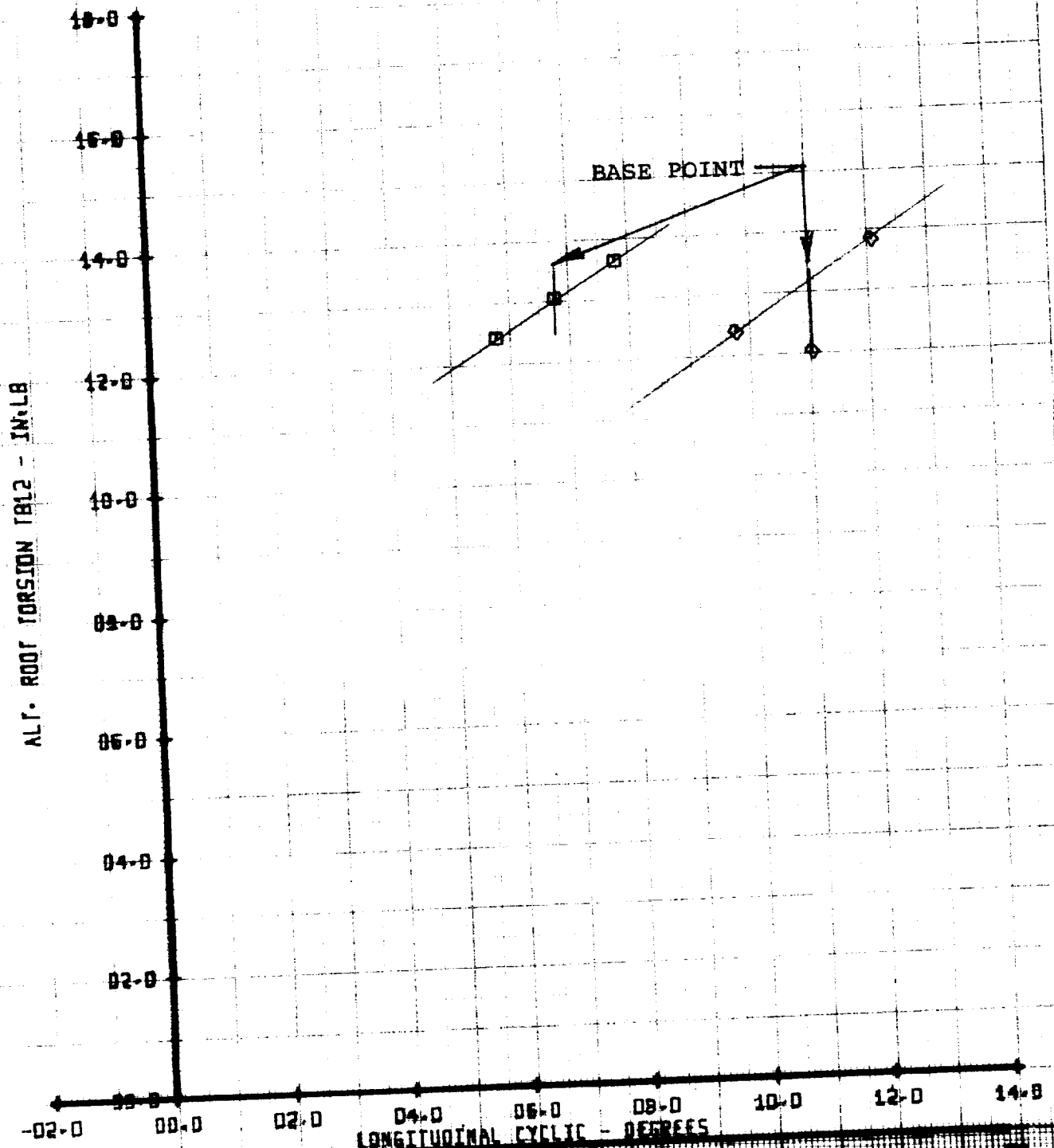


Figure C-203

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND					
SYM	RUN	MU	X/00258	CT'/58	VTUN
B A	39	.50	.05	.098	310
	39	.50	.05	.078	310

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

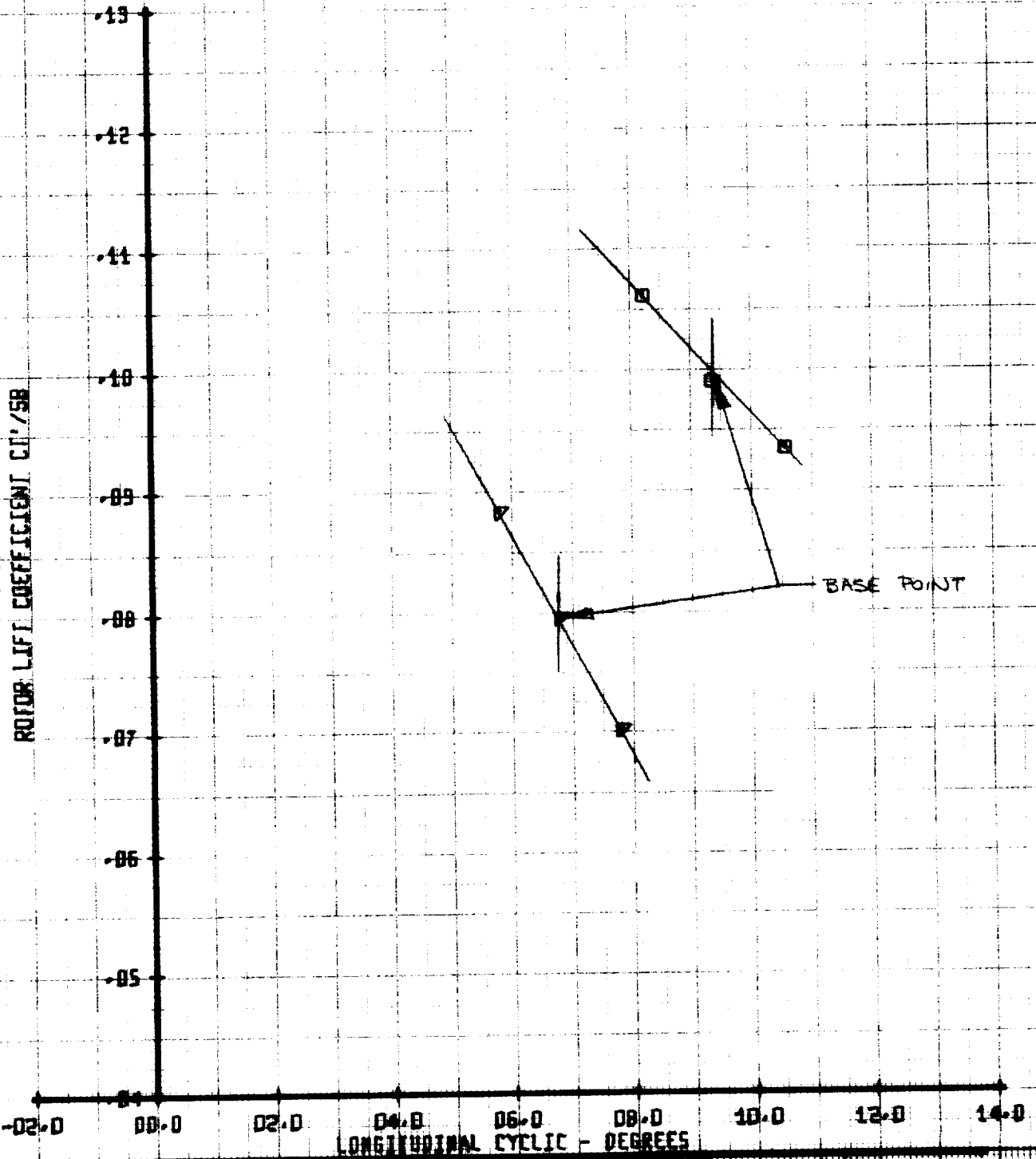


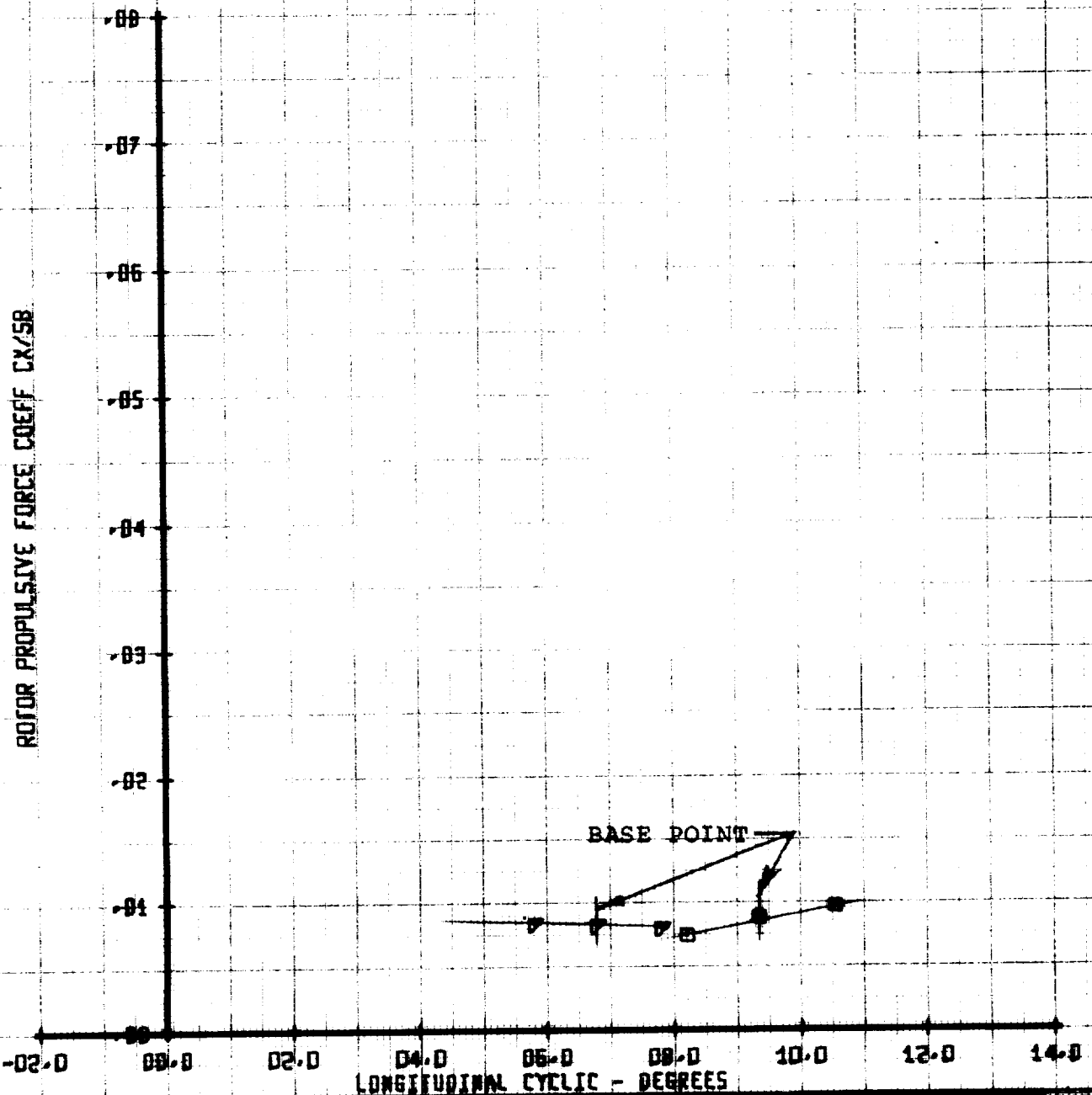
Figure C-204

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD25B	CT/5B	VTUN
0	39	.50	.05	.050	310
1	39	.50	.05	.078	310

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



SET 29
BVWT 187

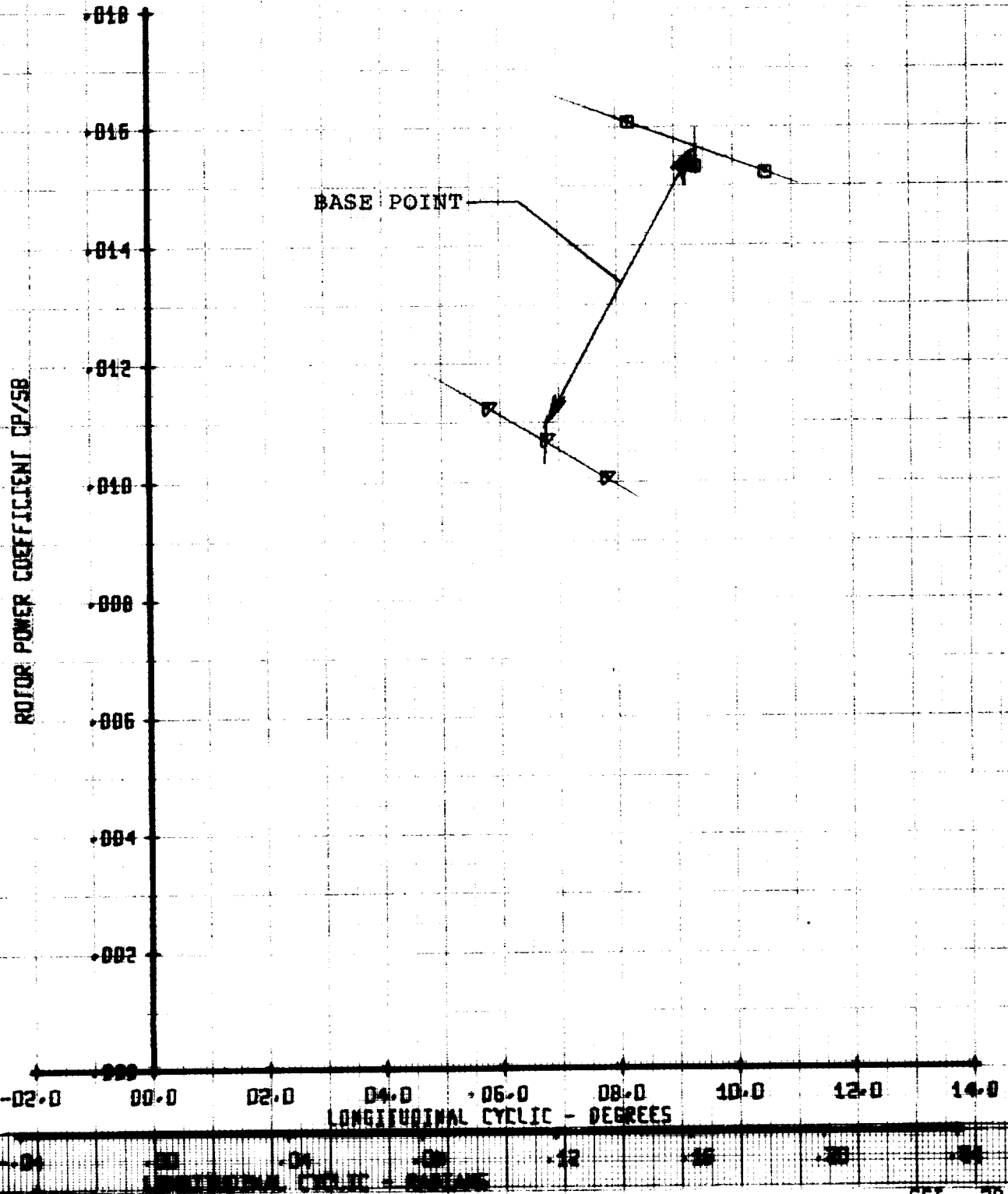
Figure C-205

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SIM	RUN	MU	X/00258	CT/58	Y/TUN
0	39	.50	.05	.030	310
1	39	.50	.05	.078	310

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



SET 29
BVWT 187

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
0	39	.50	.05	.098	310
1	39	.50	.05	.078	310

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

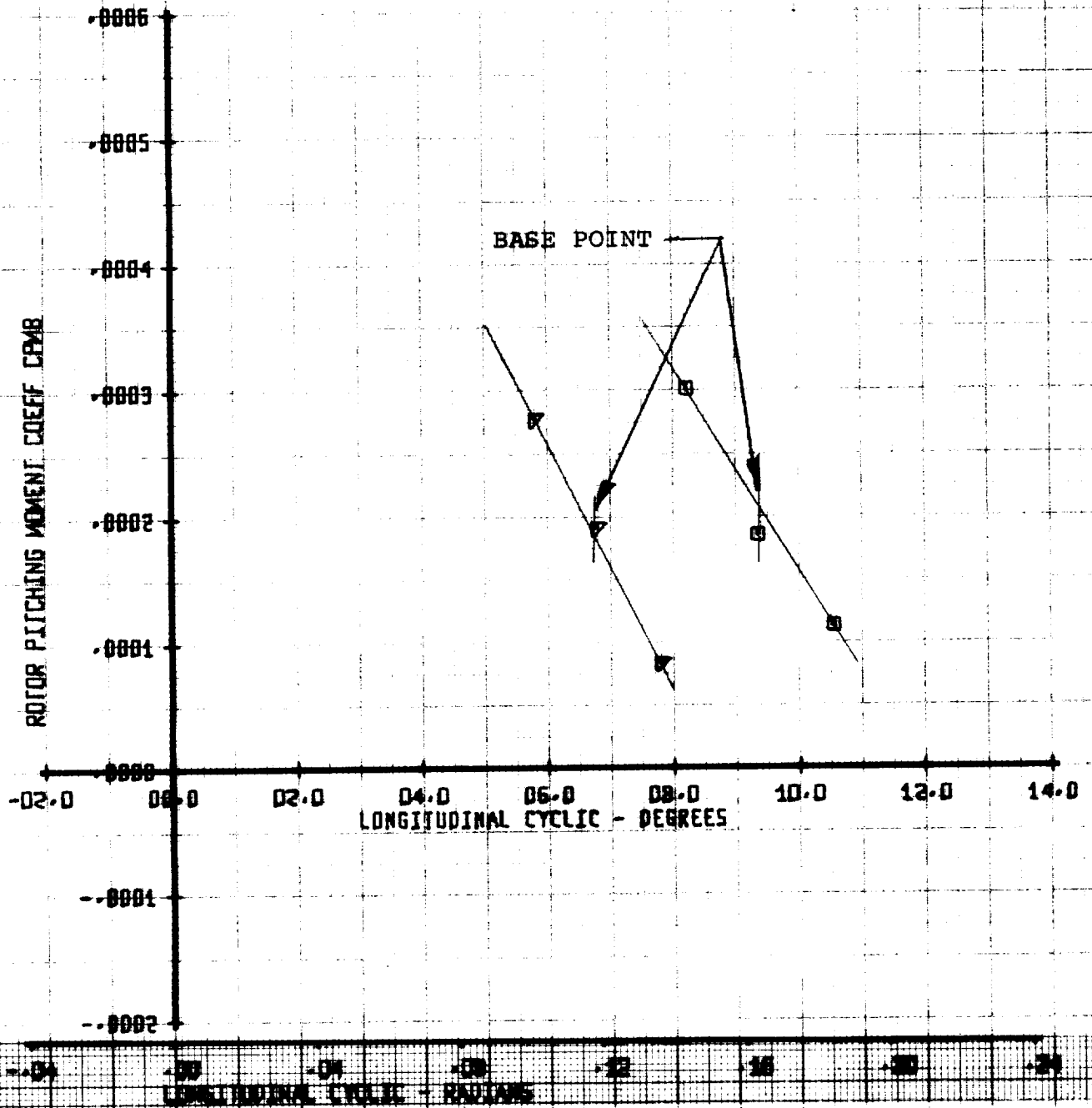


Figure C-207

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SIM	RUN	MP	X/00258	CT'/98	VTUN
39	39	.50	.05	.098	310
39	39	.50	.05	.078	310

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

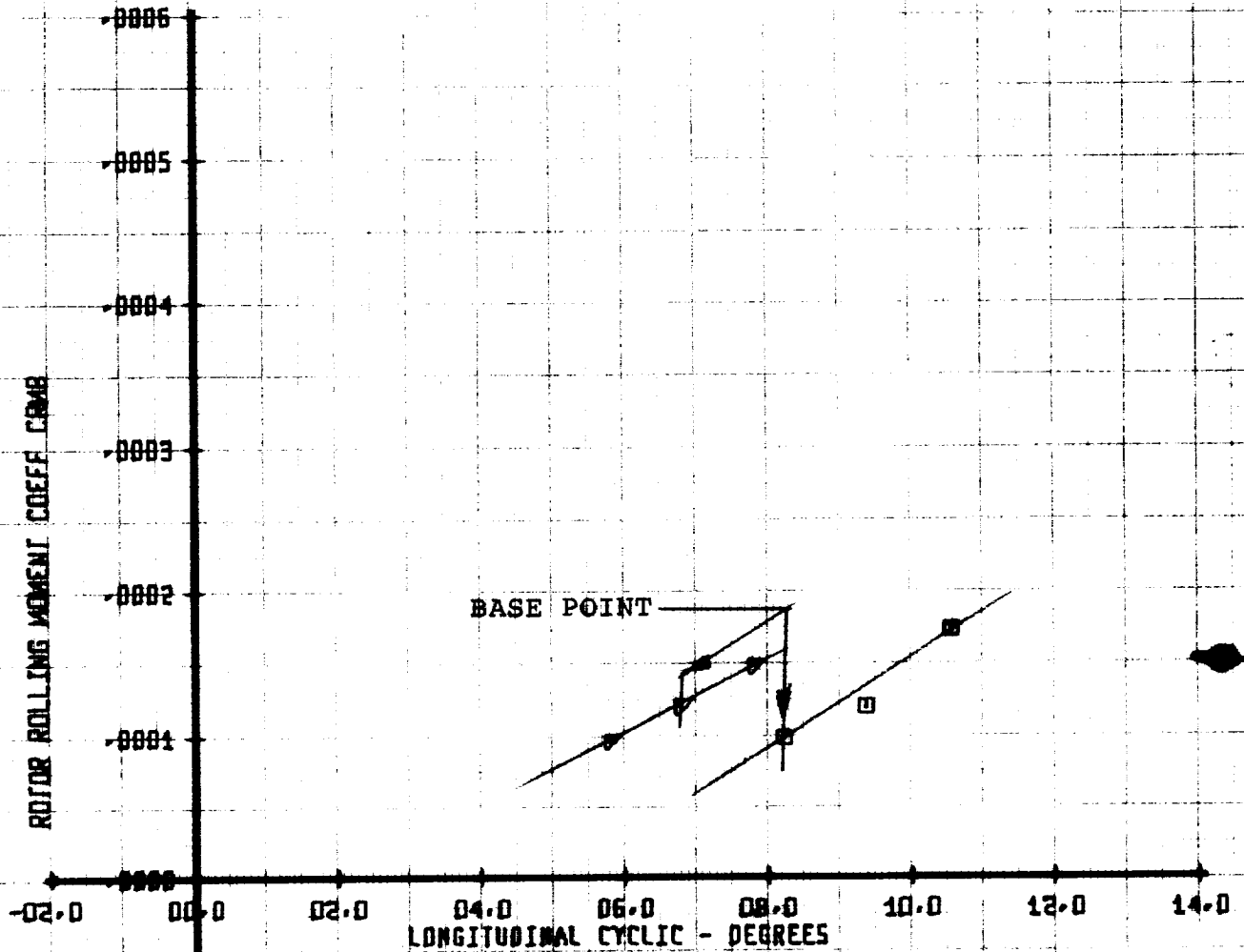


Figure C-208

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SIM	RUN	MI ²	X/002SB	CT ² /SB	VIUN
04	39	.50	.05	.098	340
04	39	.50	.05	.078	340

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

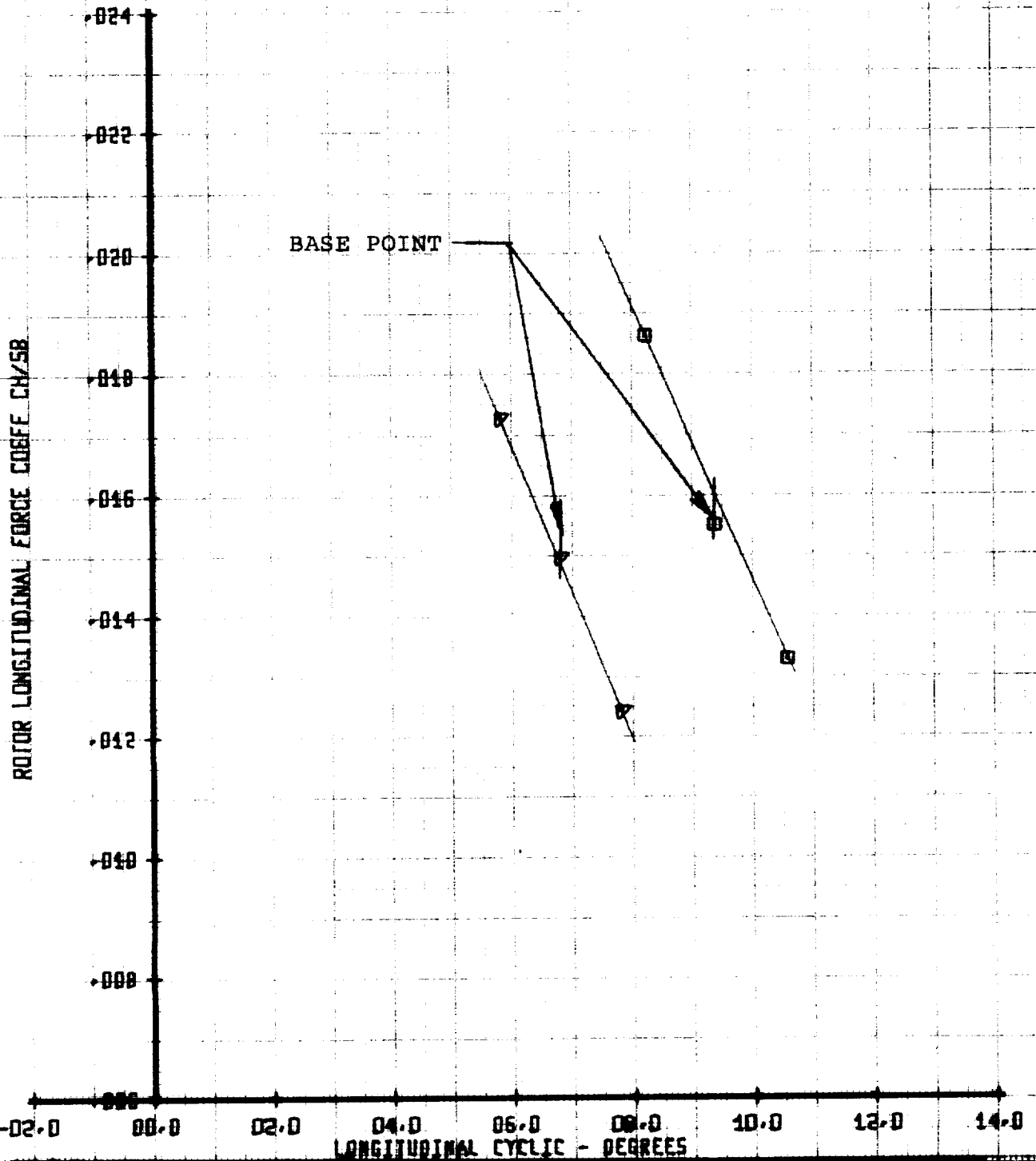


Figure C-209

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/SB	VTUN
0	39	.50	.05	.030	310
7	39	.50	.05	.078	310

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

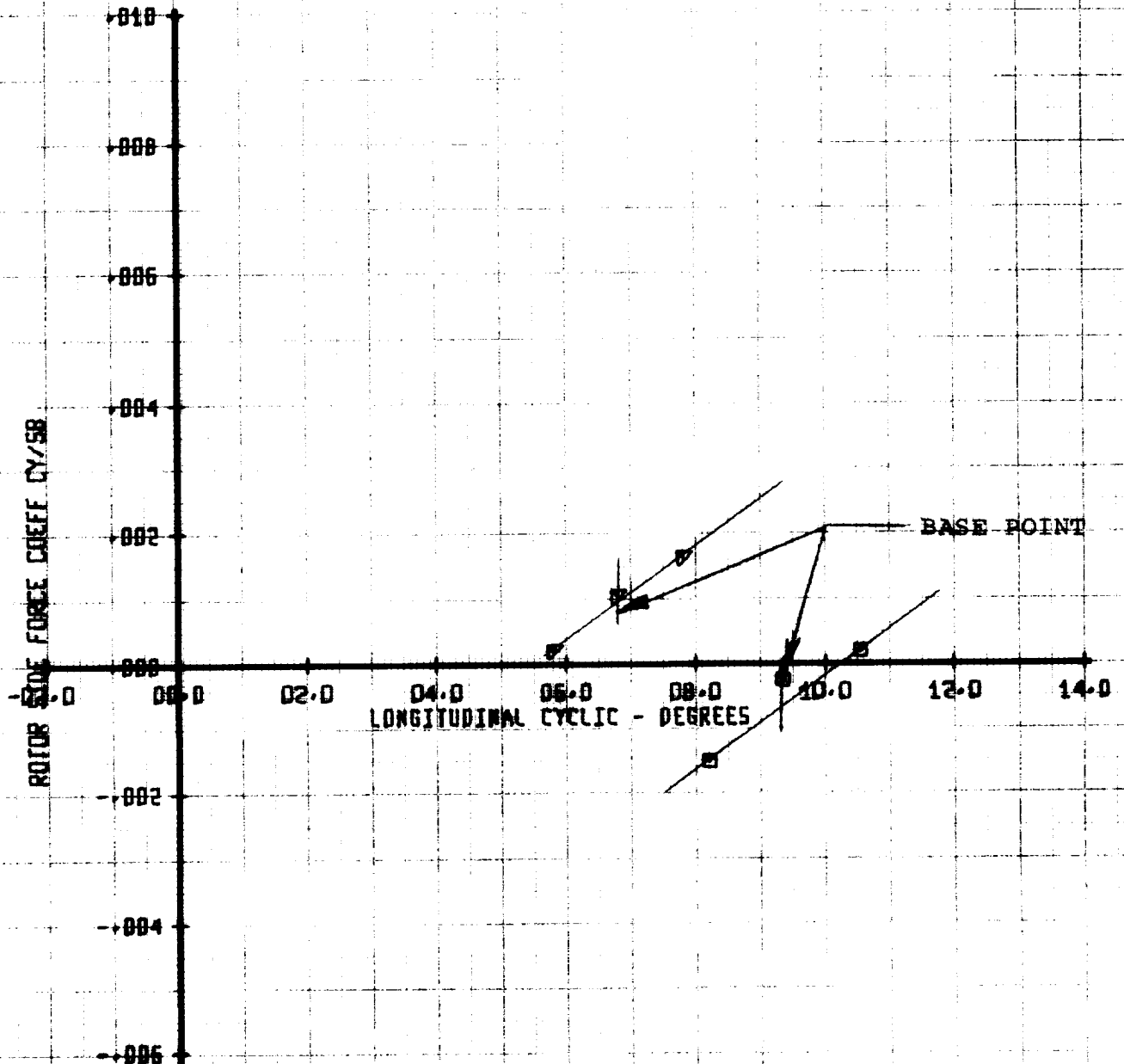


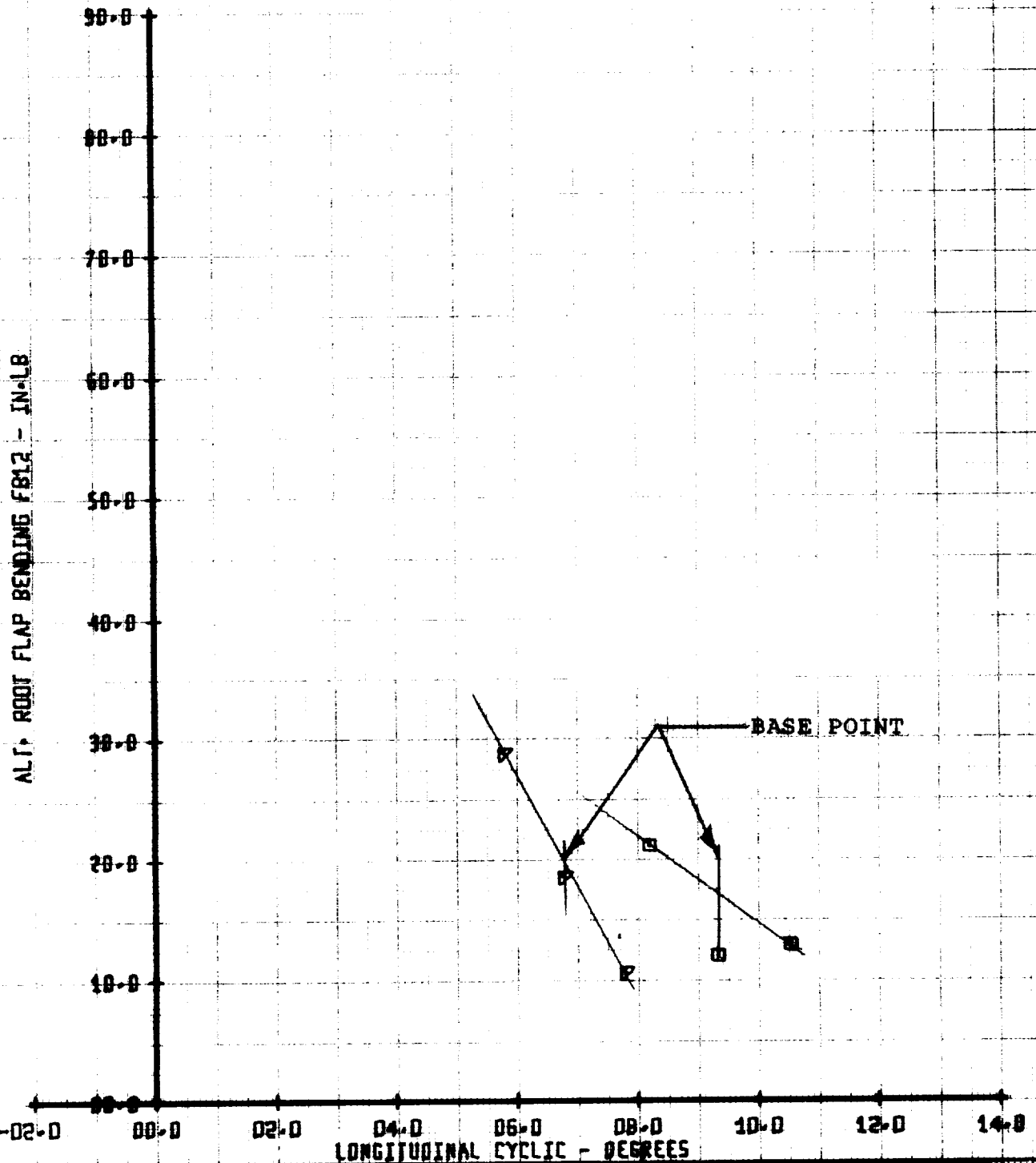
Figure C-210

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/0025B	CT/5B	VIUN
□	39	.50	.05	.090	310
△	39	.50	.05	.078	310

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC



SET 29
BVWT 187

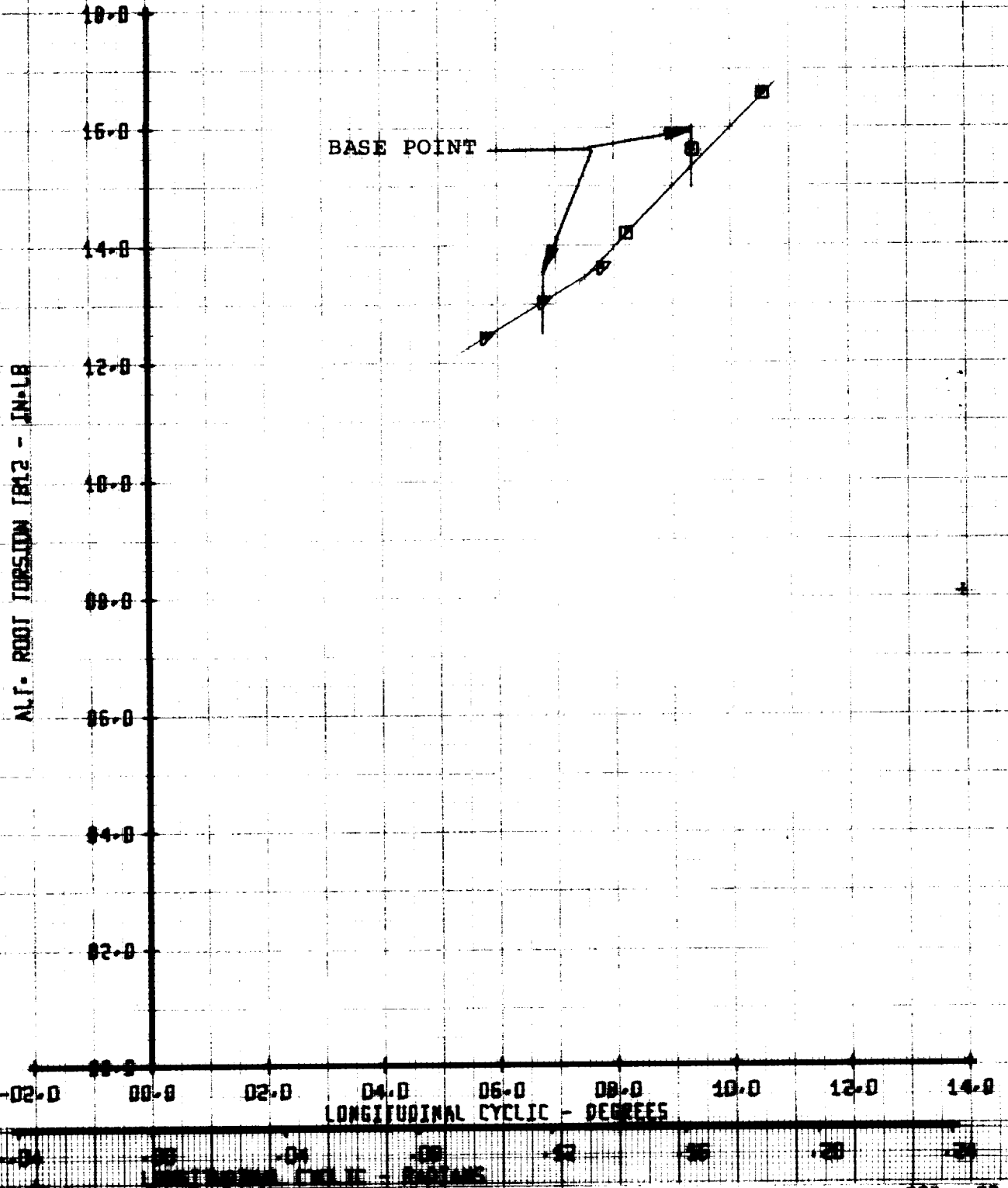
Figure C-211

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	Y/TUN
□	39	.50	.05	.030	310
△	39	.50	.05	.078	310

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC



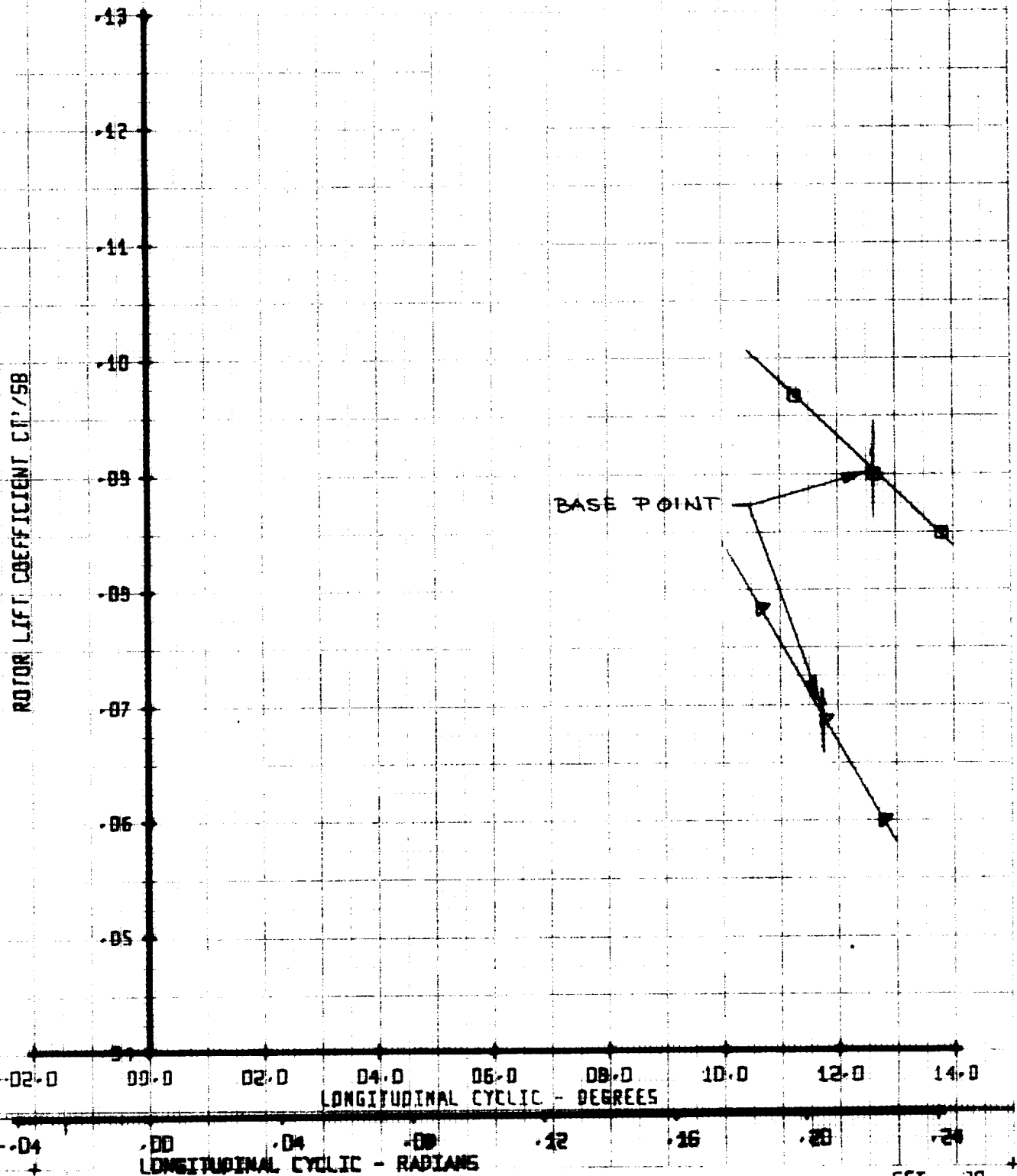
SET 29
BVWT 187

Figure C-212

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND		MU	X/DB25B	CT'/SB	YTUN
SYM	RUN				
0	41	.50	.10	.090	310
7	41	.50	.10	.069	310

ROTOR LIFT COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC



SET 30
 BVWT 197

Figure C-213

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE OH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DB258	CT/58	VTUN
0	41	.50	.10	.090	310
0	41	.50	.10	.069	310

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

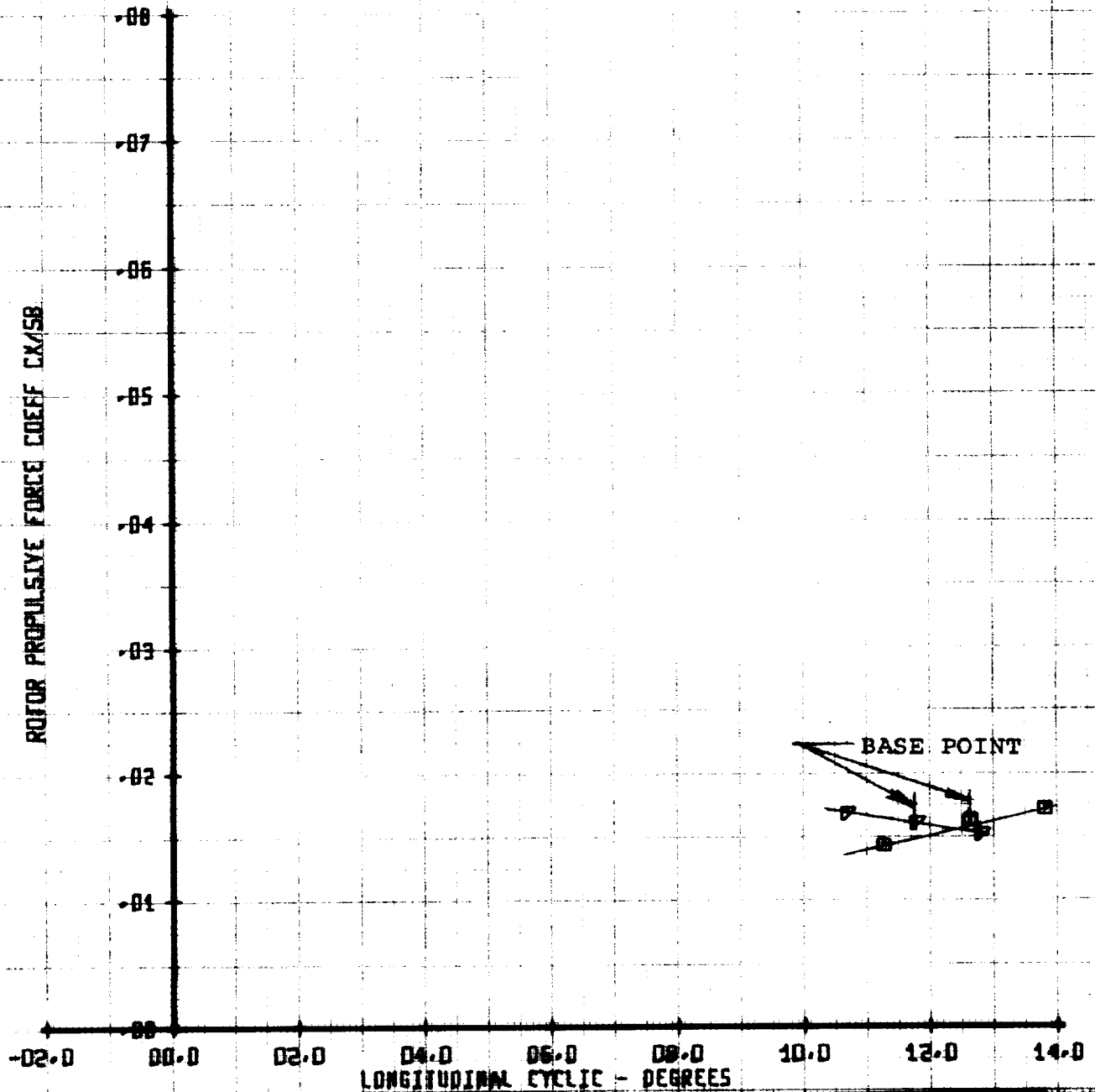


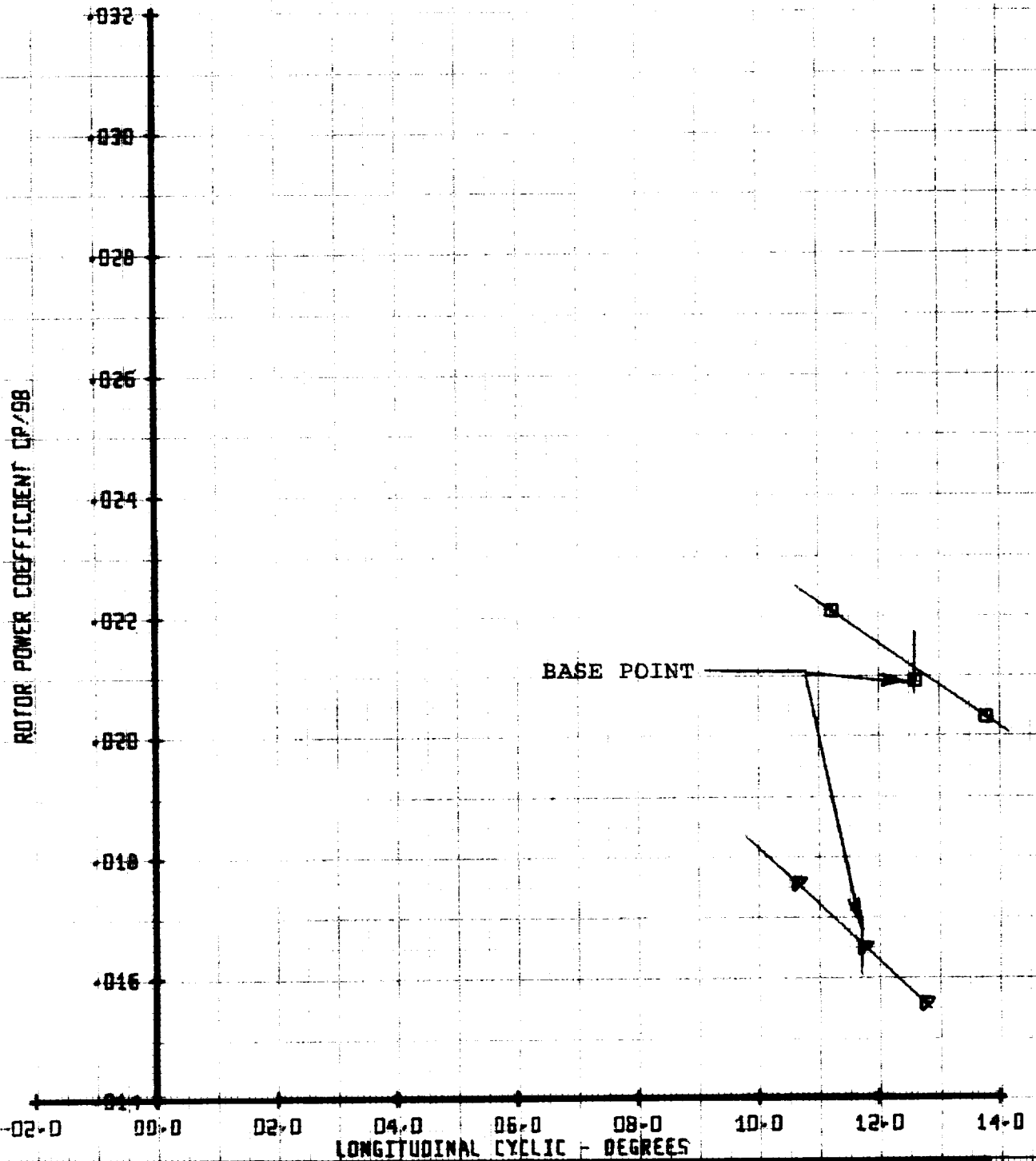
Figure C-214

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

S/M	RUN	MU	X/00258	CT'/SB	VTUN
0	41	.50	.10	.090	310
0	41	.50	.10	.069	310

ROTOR POWER COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC



LONGITUDINAL CYCLIC - RADIANS

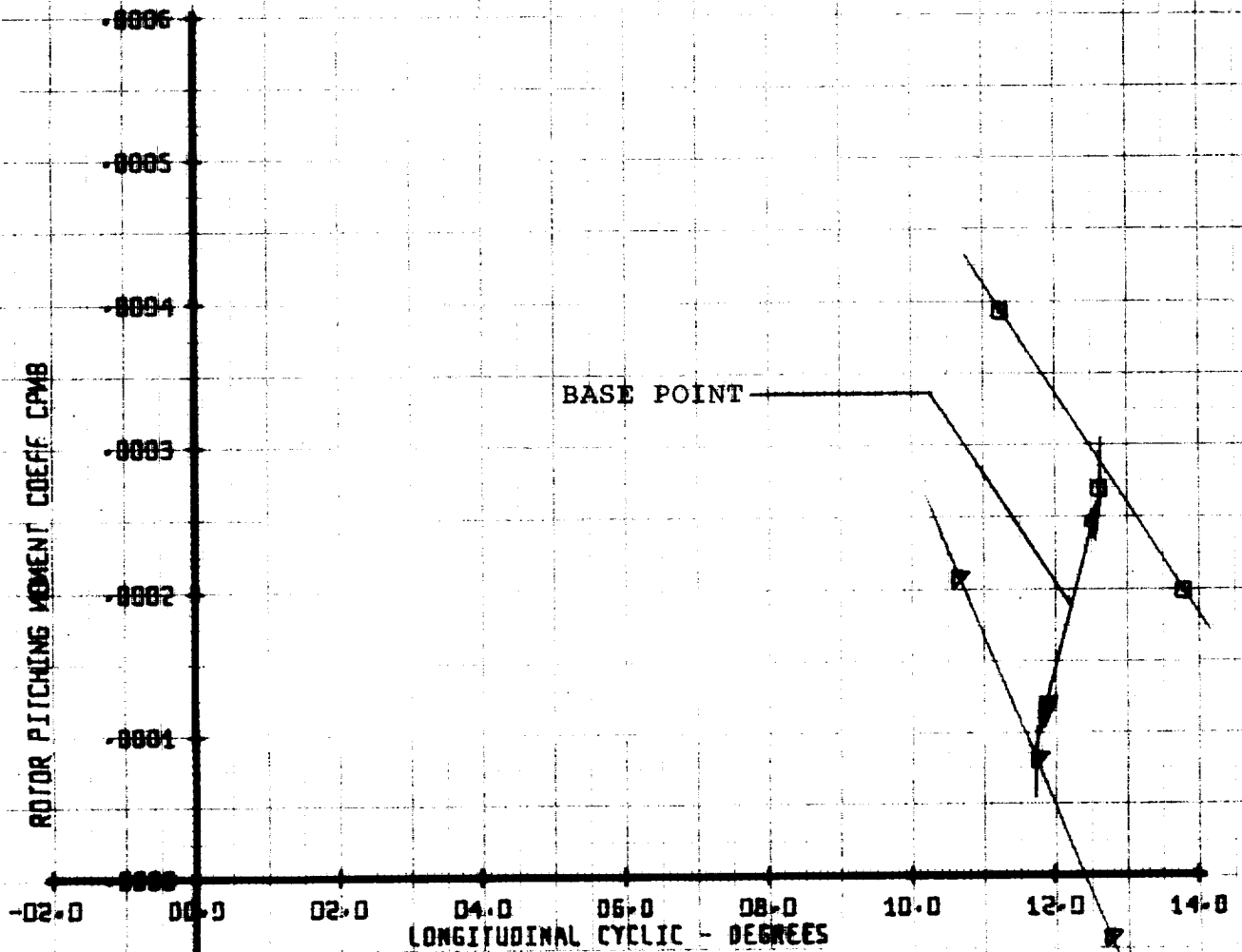
SET 30
 BVWT 187

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	1/00258	CT/58	VTUN
0	41	.50	.10	.090	310
8	41	.50	.10	.069	310

ROTOR PITCHING MOMENT COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD258	CT'/SB	Y/LIN
0	41	.50	.10	.090	3:10
1	41	.50	.10	.069	3:10

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

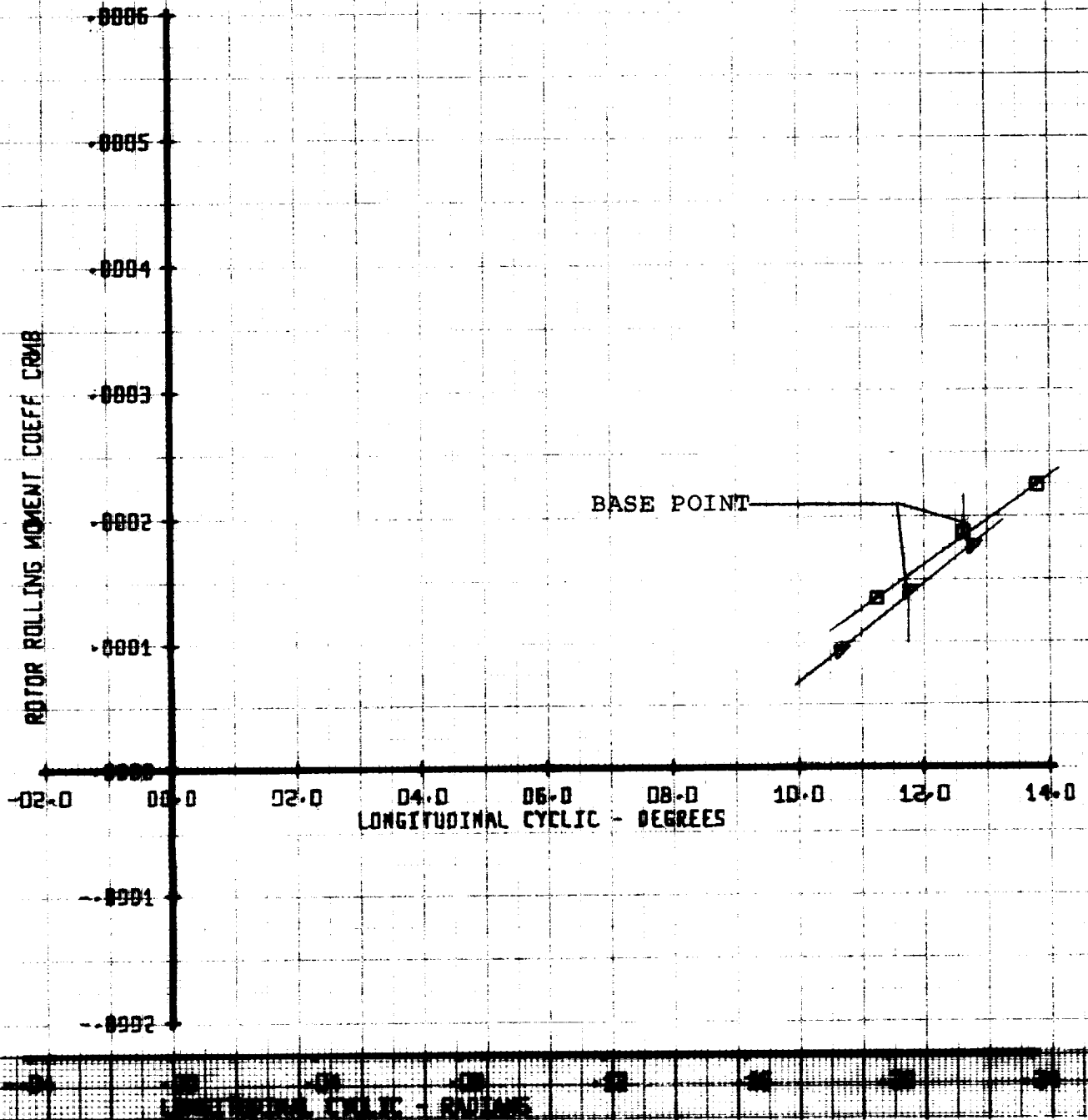


Figure C-217

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

S/N	RUN	MU	X/00258	CT'/SB	VTUN
0	41	.50	.10	.090	310
4	41	.50	.10	.069	310

ROTOR LONGITUDINAL FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

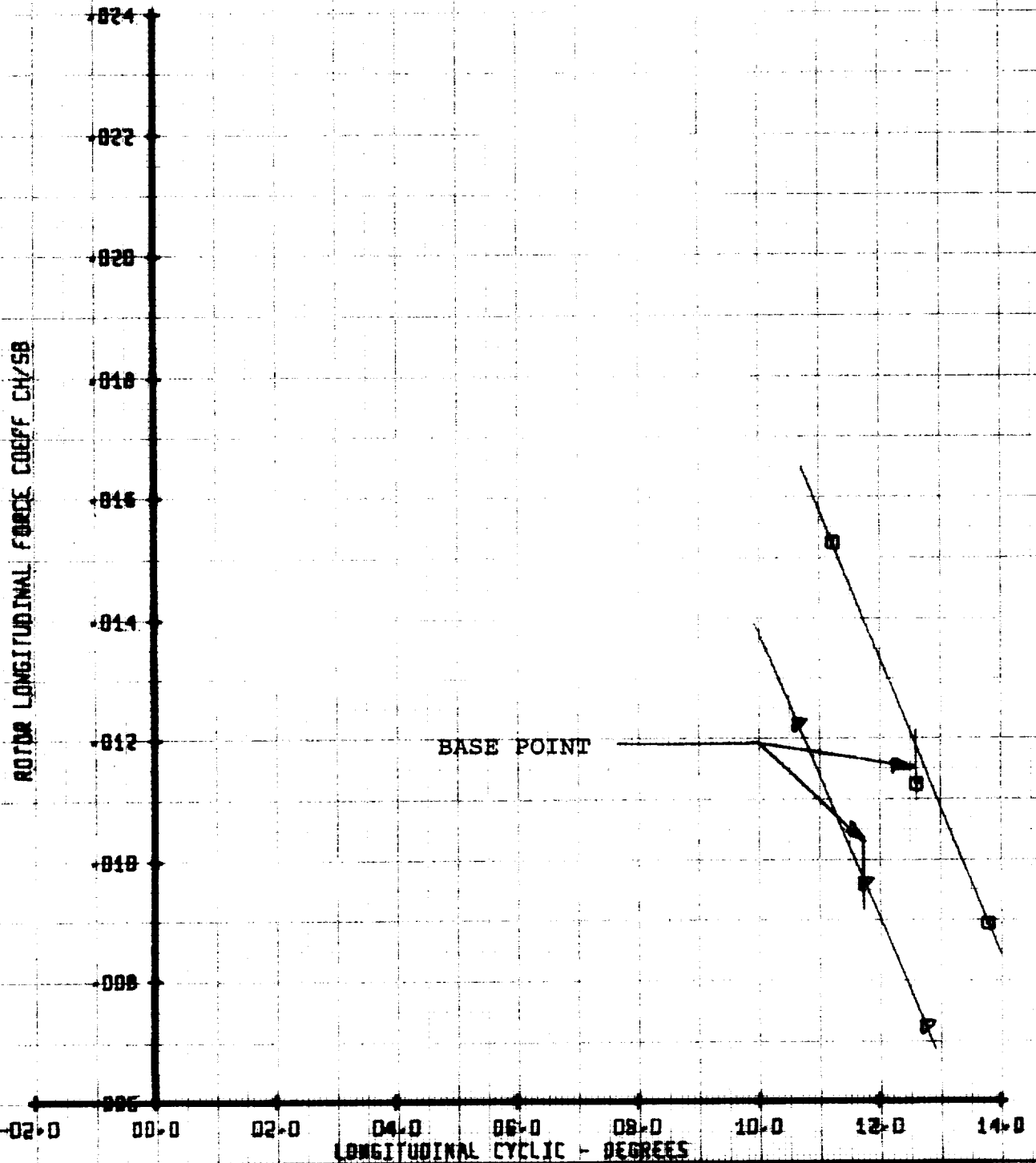


Figure C-218

LIFT-PROPULSIVE FORCE LIMIT TEST

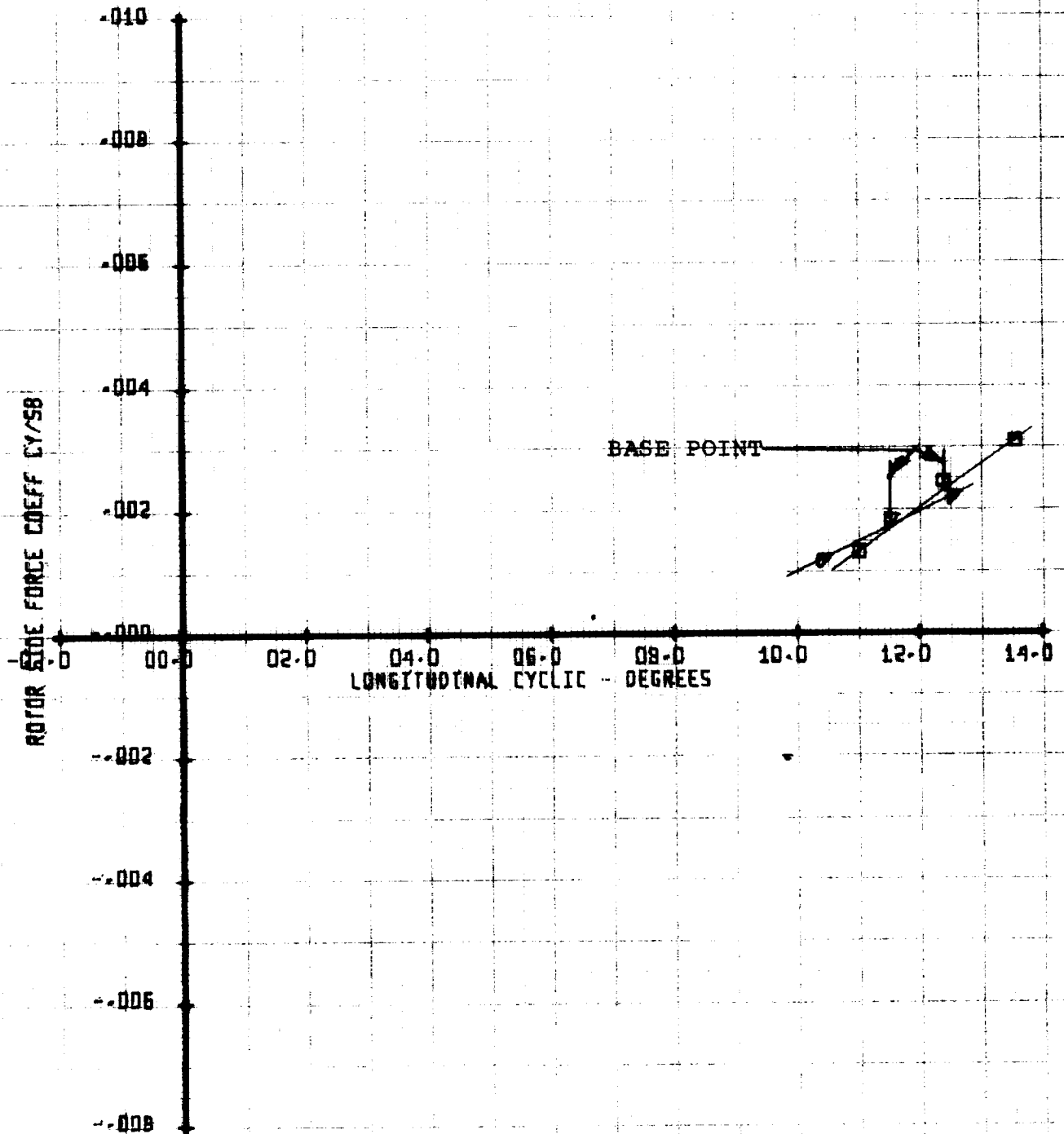
1/10 SCALE CH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	1/0025PCT/58	VIUN
41	41	.50	.10	.090
41	41	.50	.10	.089
				310
				310

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



LONGITUDINAL CYCLIC - DEGREES

SET 30
BYWT 137

LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CH-47E ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DO258	CT/EB	VTUN
□	41	.50	.10	.090	310
▽	41	.50	.10	.069	310

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC

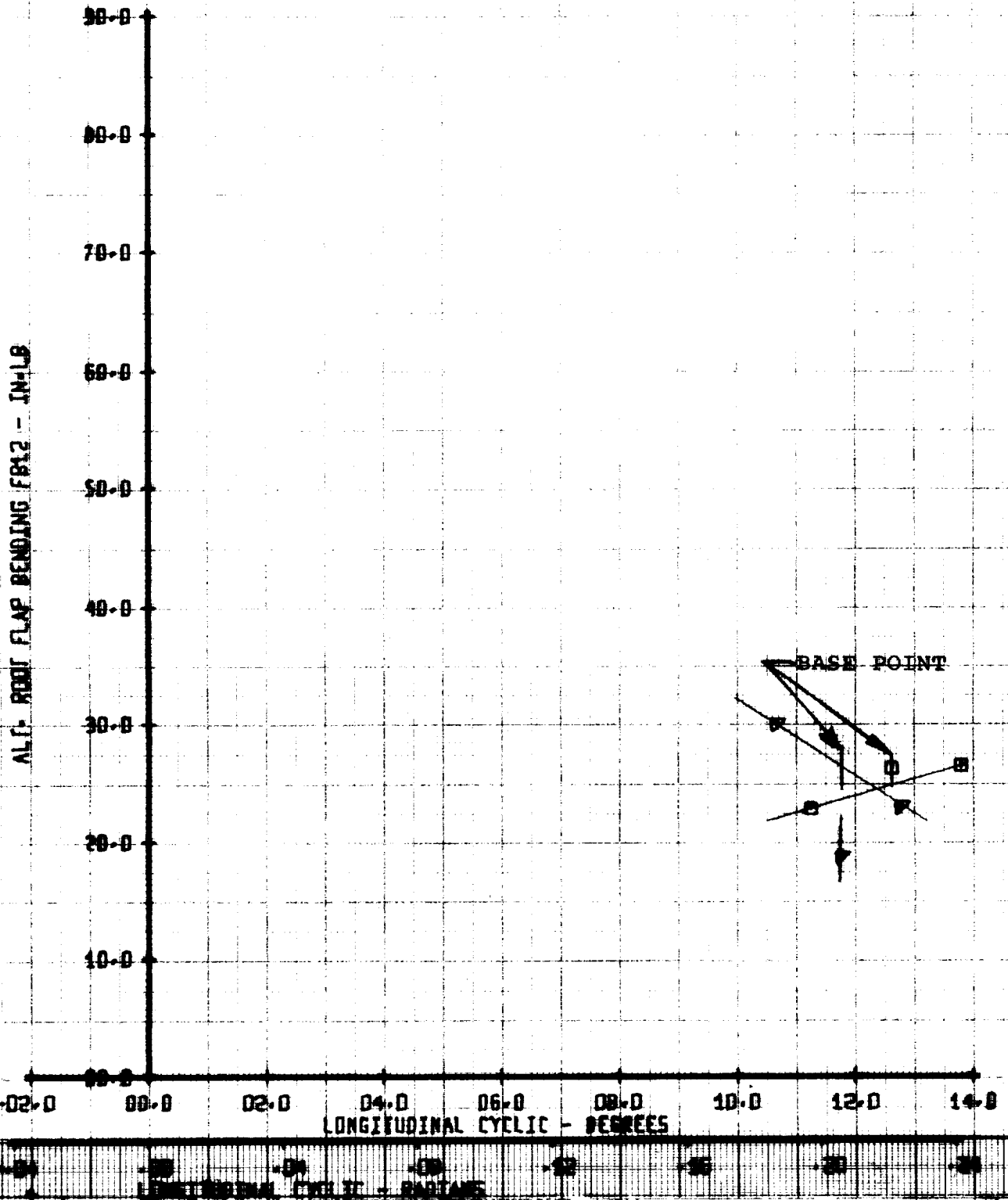
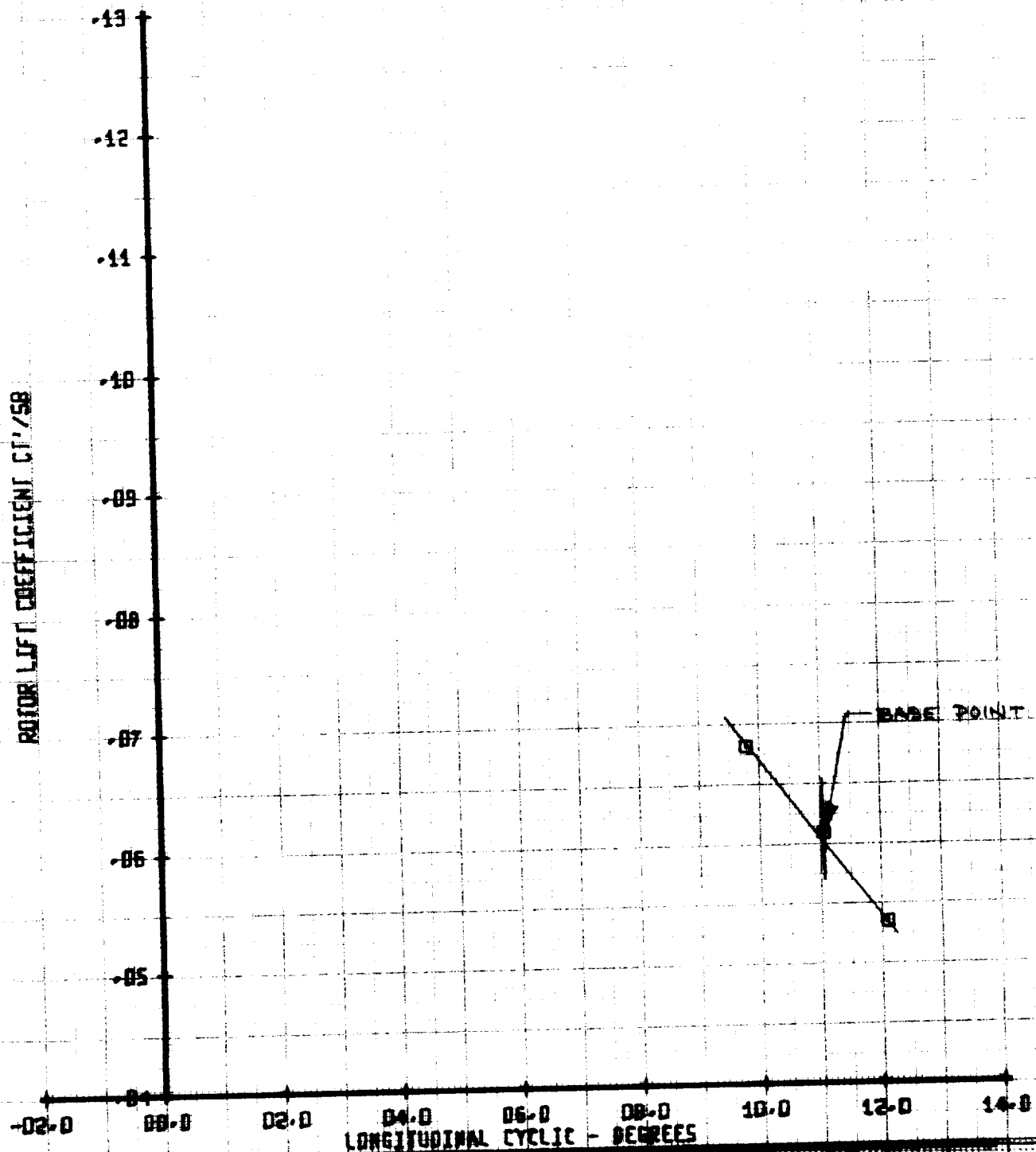


Figure C-220

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND
SYM RUN MU' X/00288 CT'/58 YTIM
□ 42 .50 .20 .059 310

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



SET 31
BVWT 187

Figure C-221

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/58	Y/TUM
□	42	.50	.20	.059	310

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

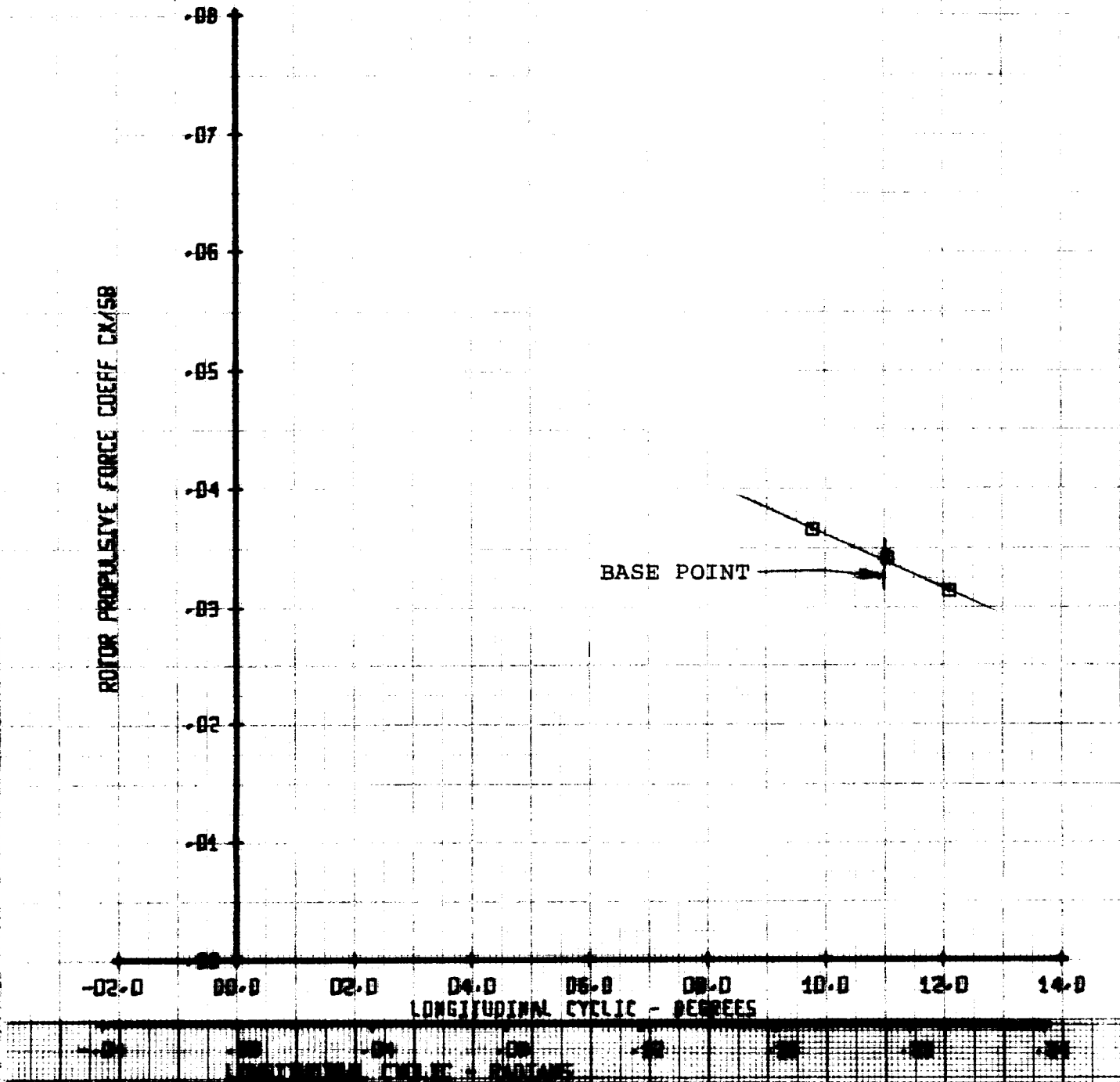


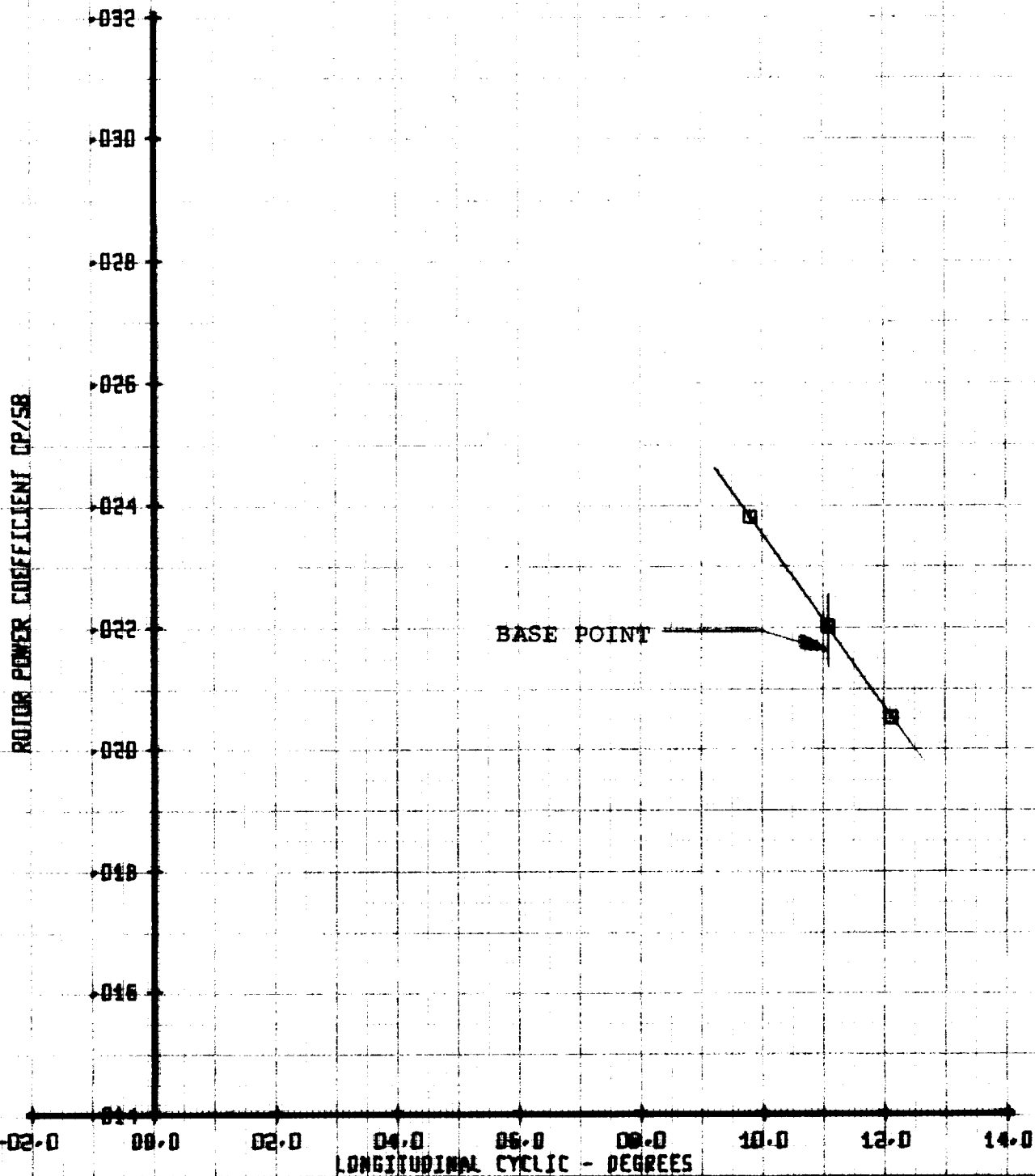
Figure C-222

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MIN	X/00258	CT/58	VTUN
0	42	.50	.20	.059	340

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE OH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	YTH
0	42	.50	.20	.053	340

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

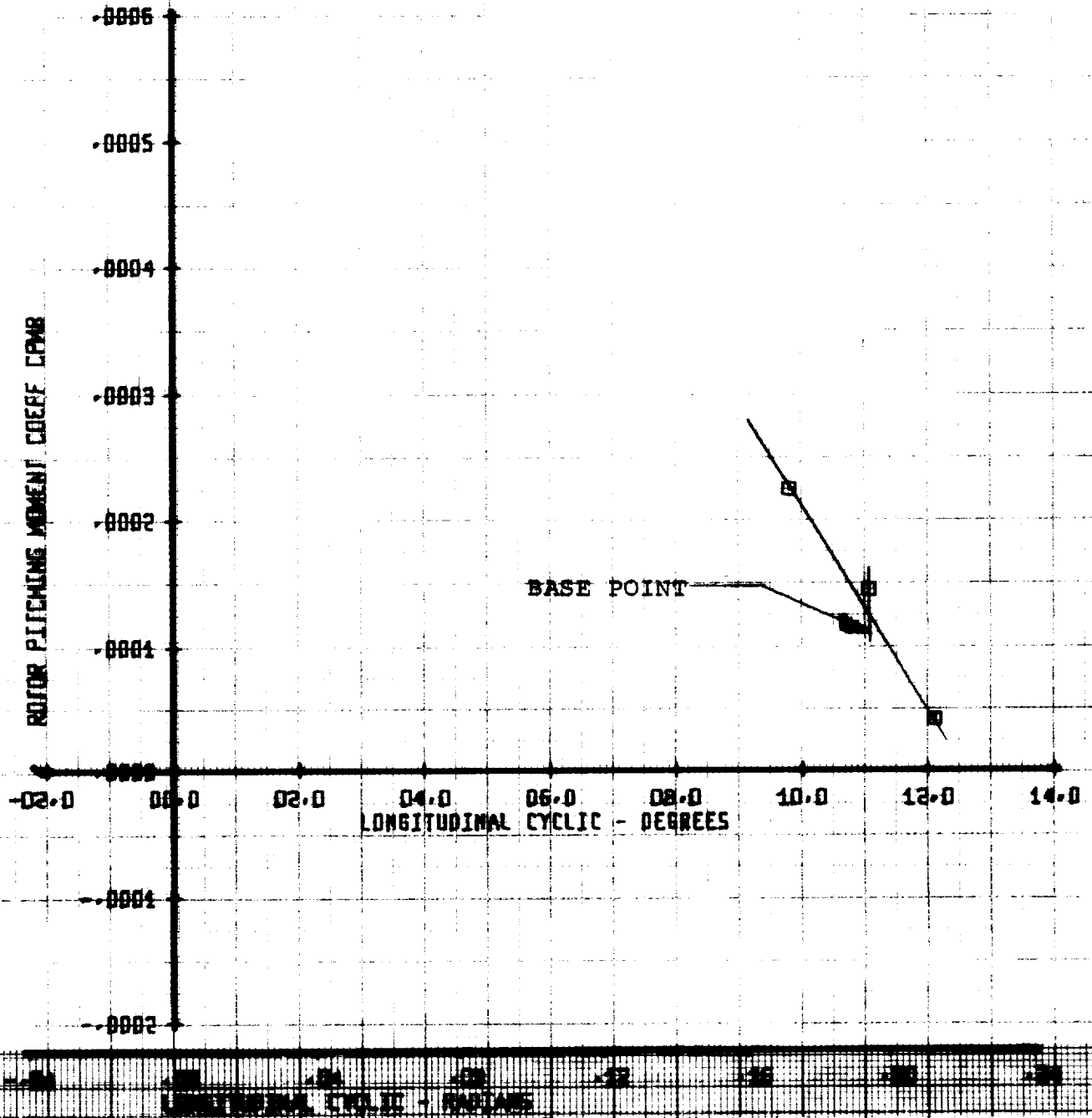


Figure C-224

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DO258	CI/SB	YIUM
0	42	.50	.20	.059	390

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

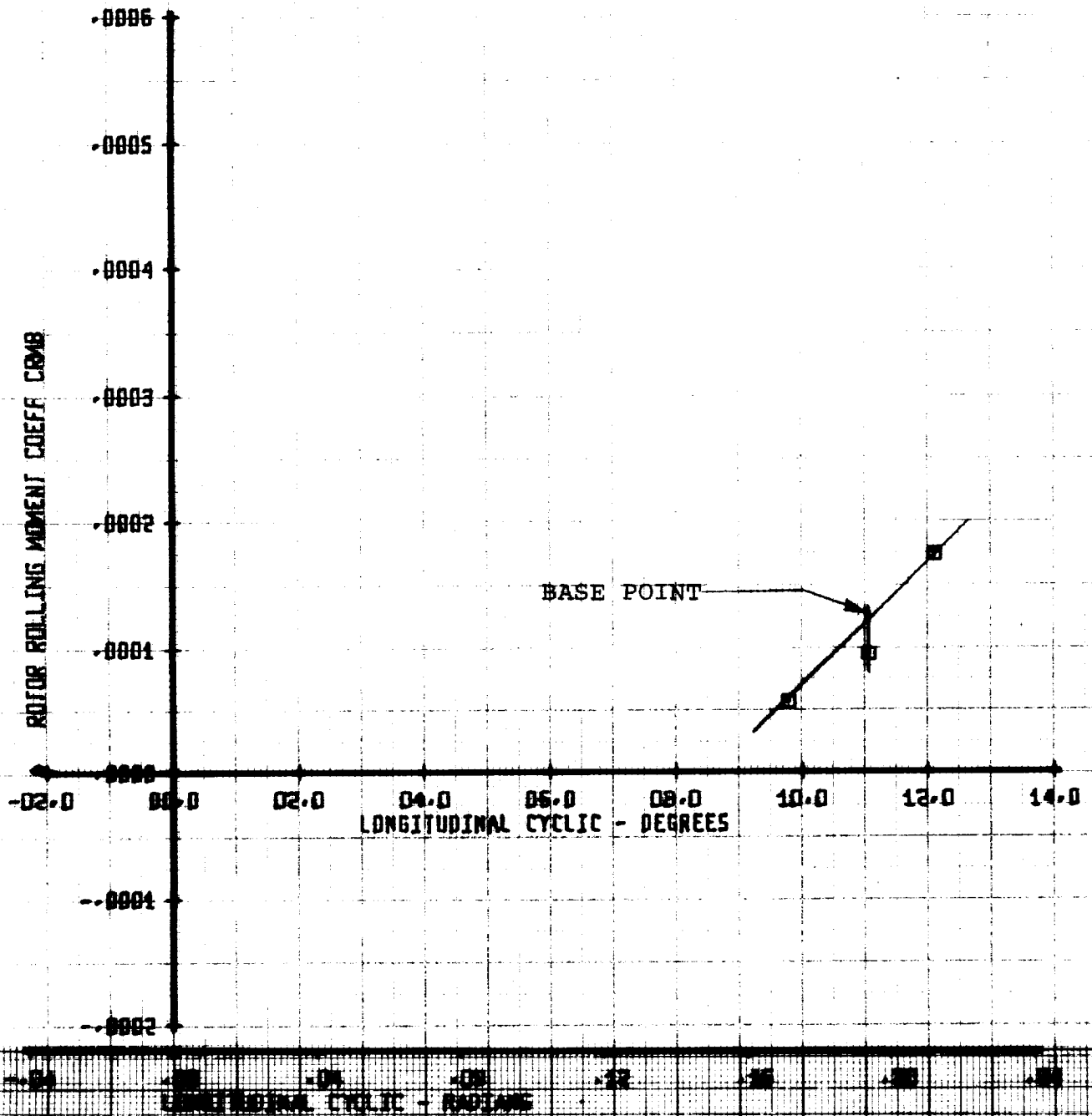


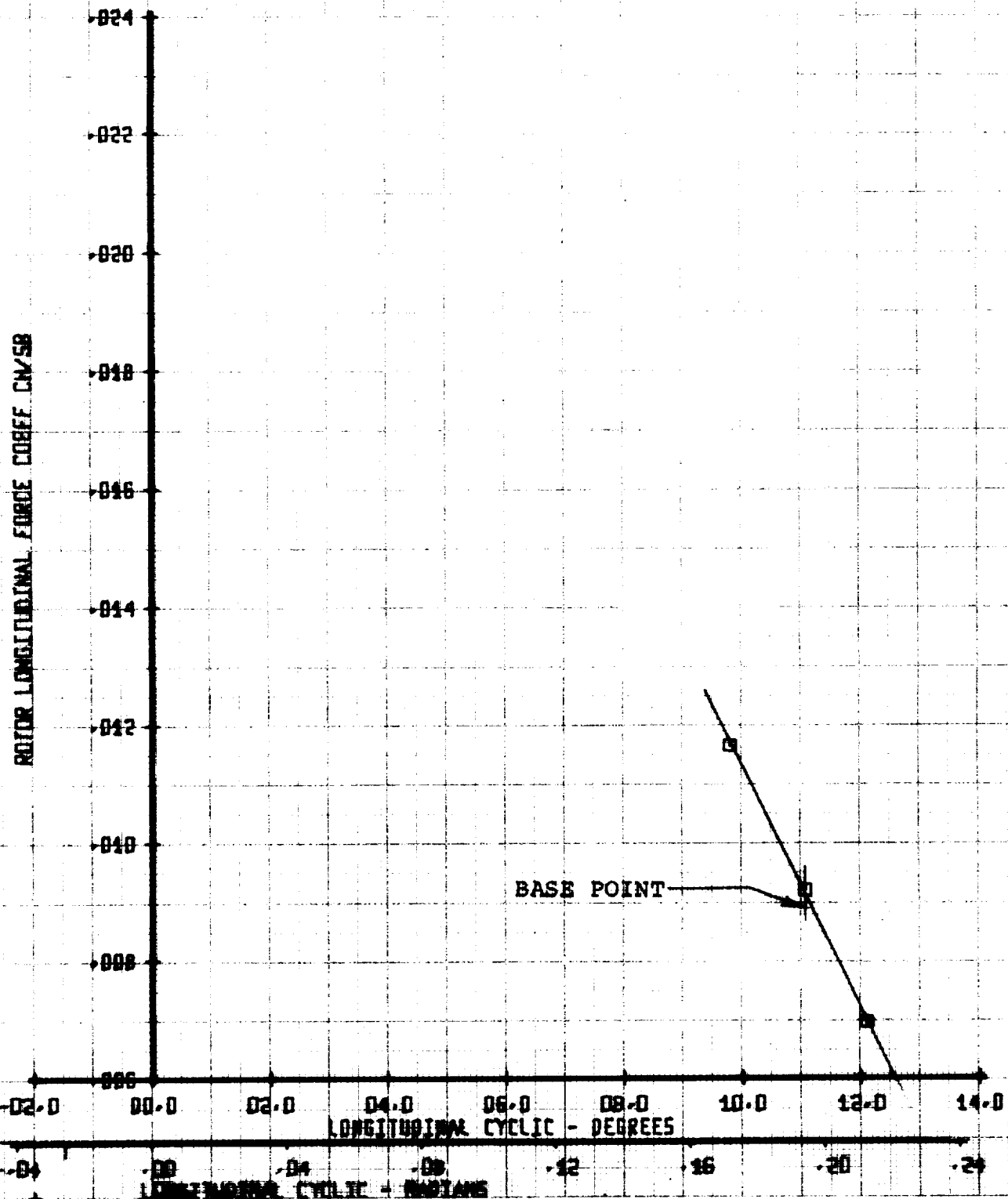
Figure C-225

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE OH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/DO258	CT/58	VTUN
Q	42	.50	.20	.059	310

ROTOR LONGITUDINAL FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC



SET 31
 BVWT 187

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND
SYM RUN MU' X/00258 CT'/58 Y/IN
0 42 .50 .20 .059 310

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

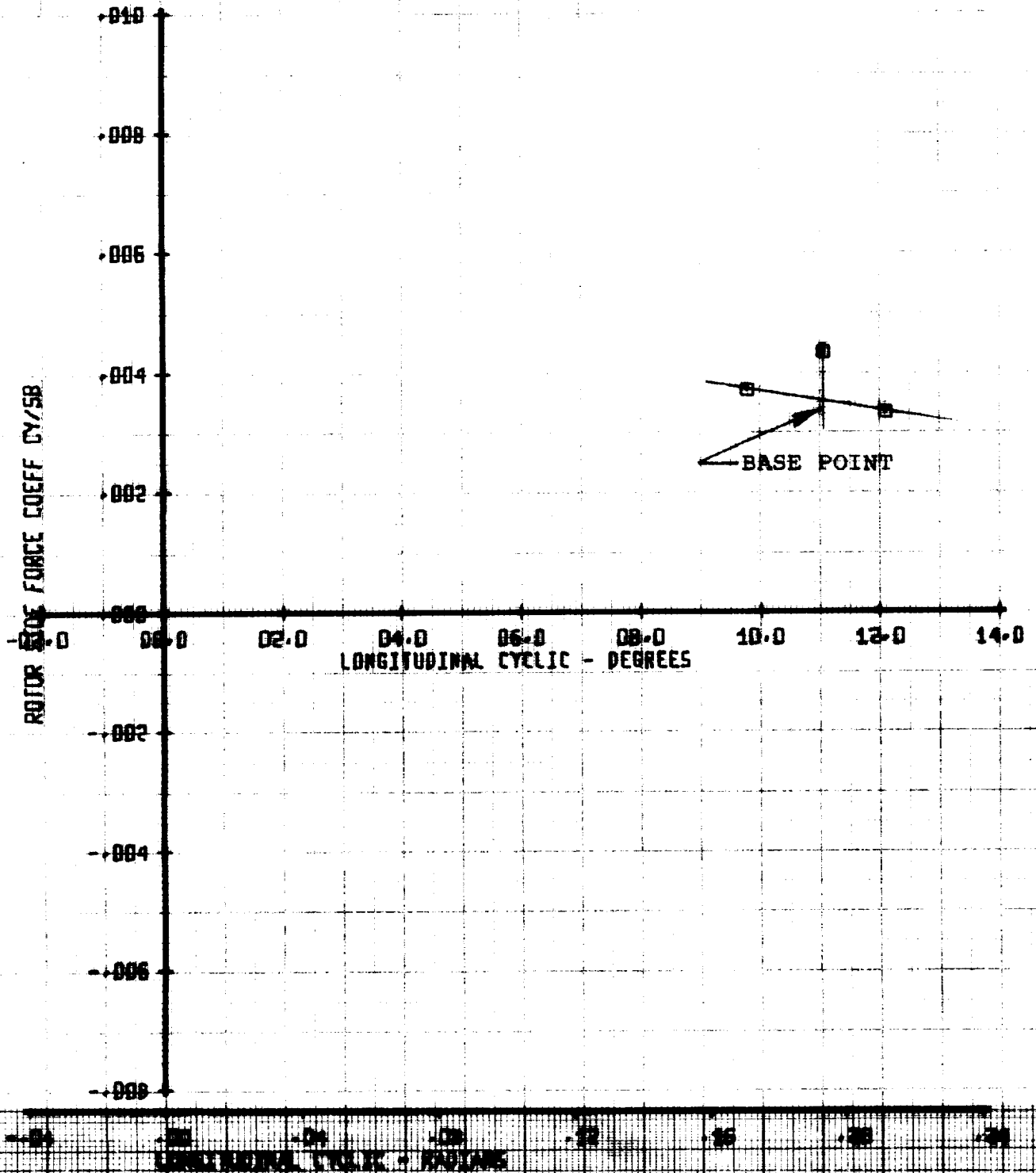


Figure C-227

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND
SYM RUN MU' X/100258 CI' /98 VITUM
0 42 .50 .20 .059 340

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC

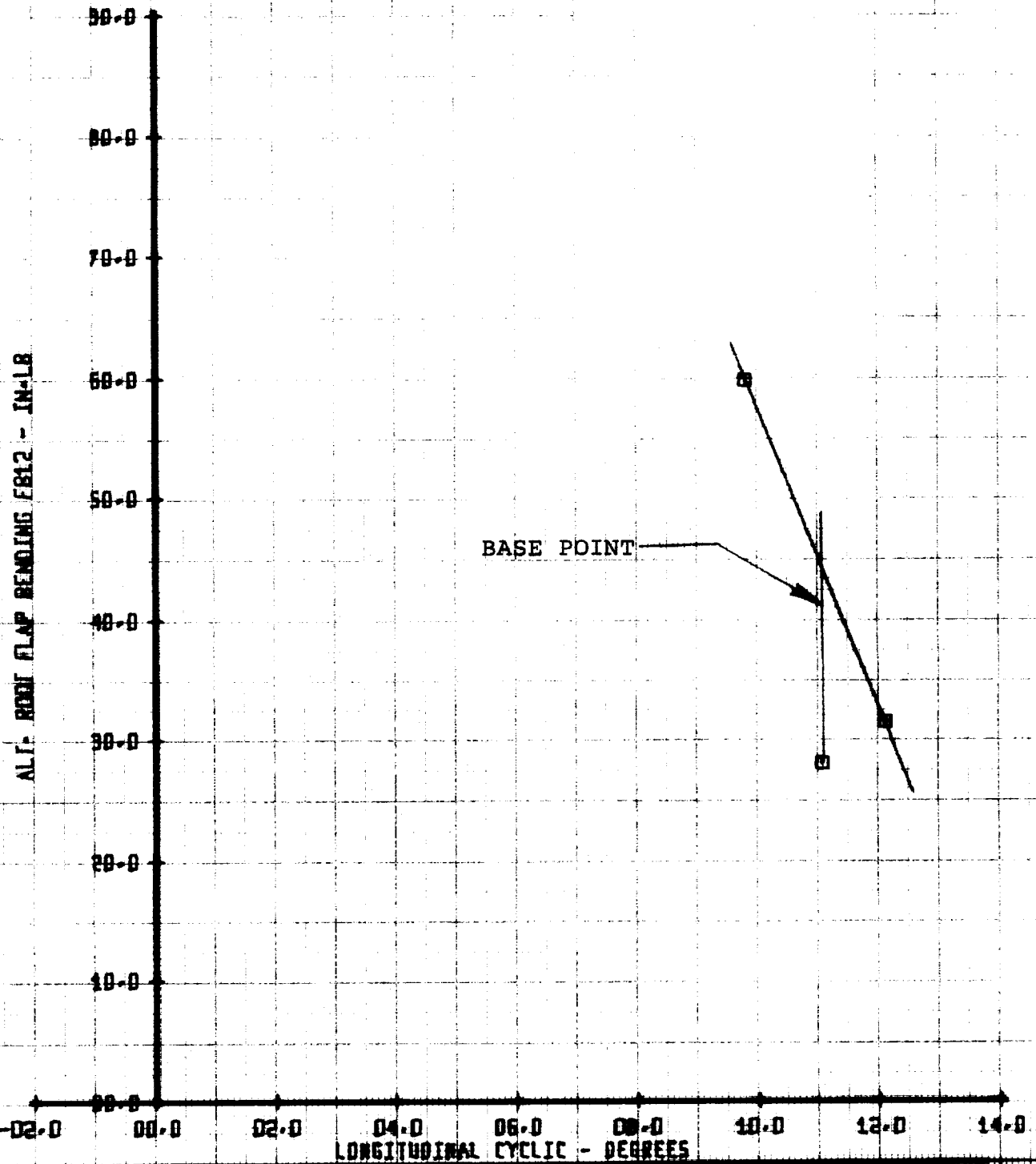


Figure C-228

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DO258	CT/58	VTUM
□	42	.50	.20	.059	310

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC

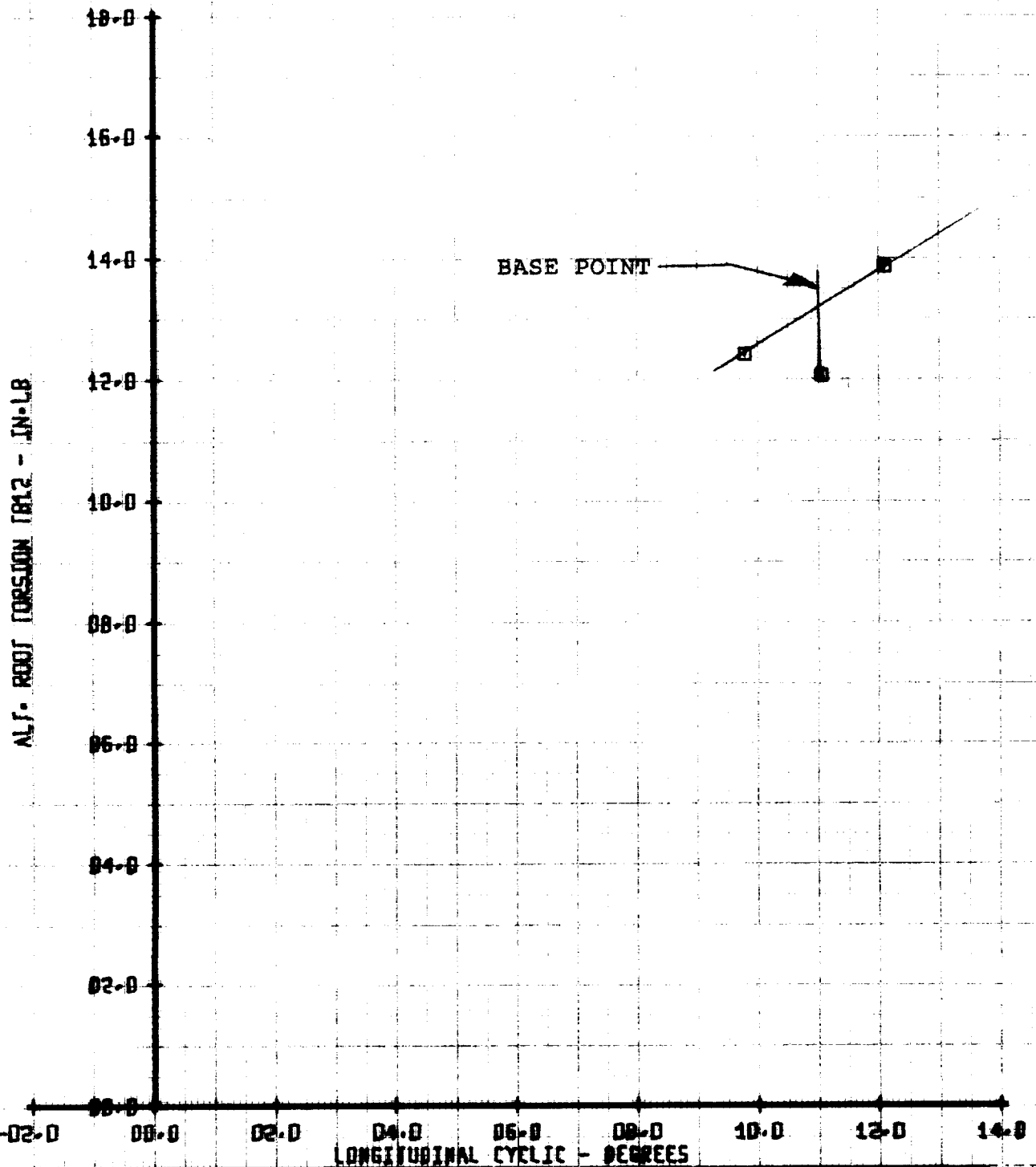


Figure C-229

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/58	VTUN
□	50	.53	.05	.102	329
△	50	.53	.05	.079	329

ROTOR LIFT COEFFICIENT
 VERSUS
 LATERAL CYCLIC

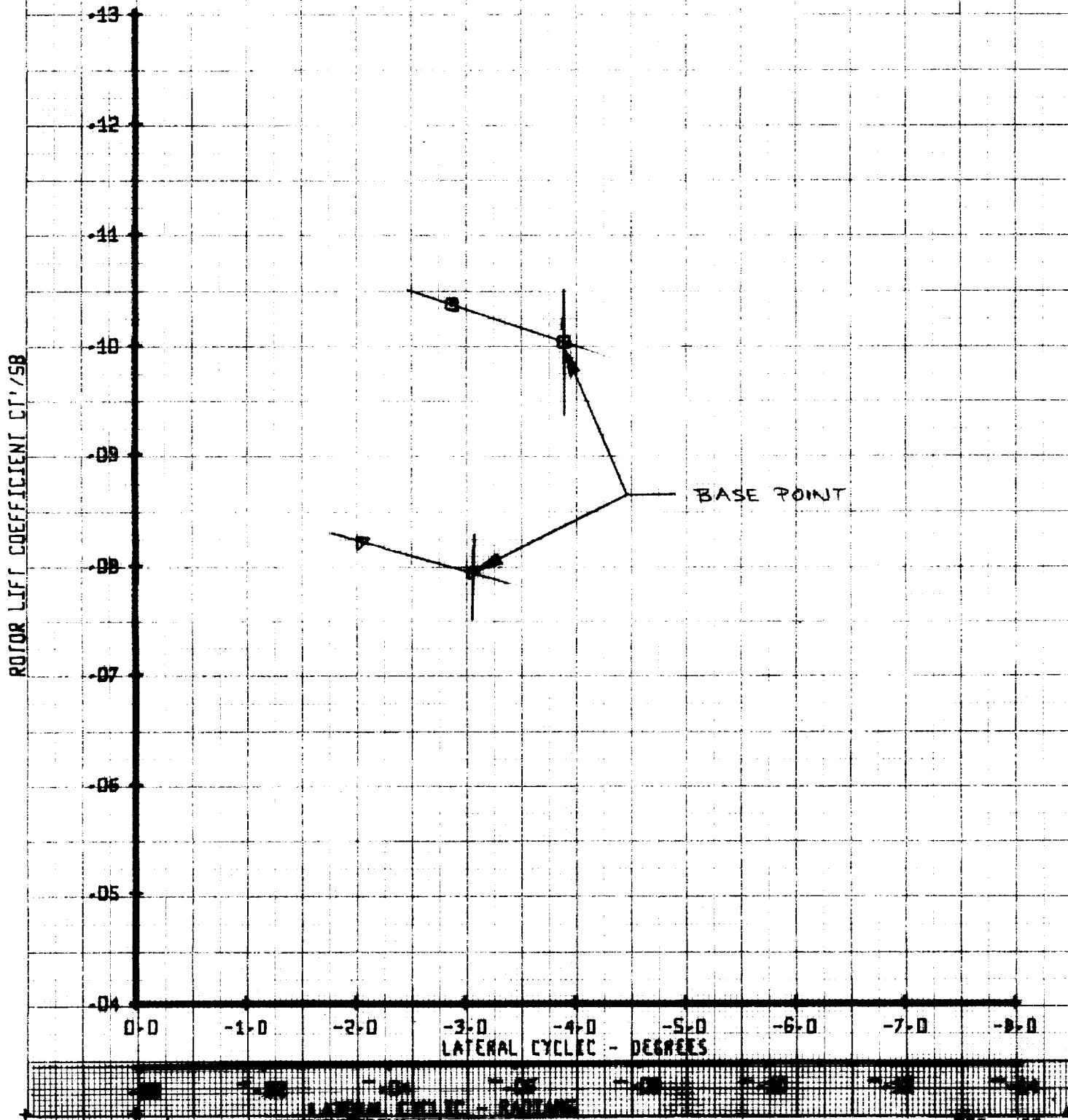


Figure C-230

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/CD258	CT/58	VTUN
0	50	.53	.05	.102	329
4	50	.53	.05	.079	329

ROTOR PROPULSIVE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

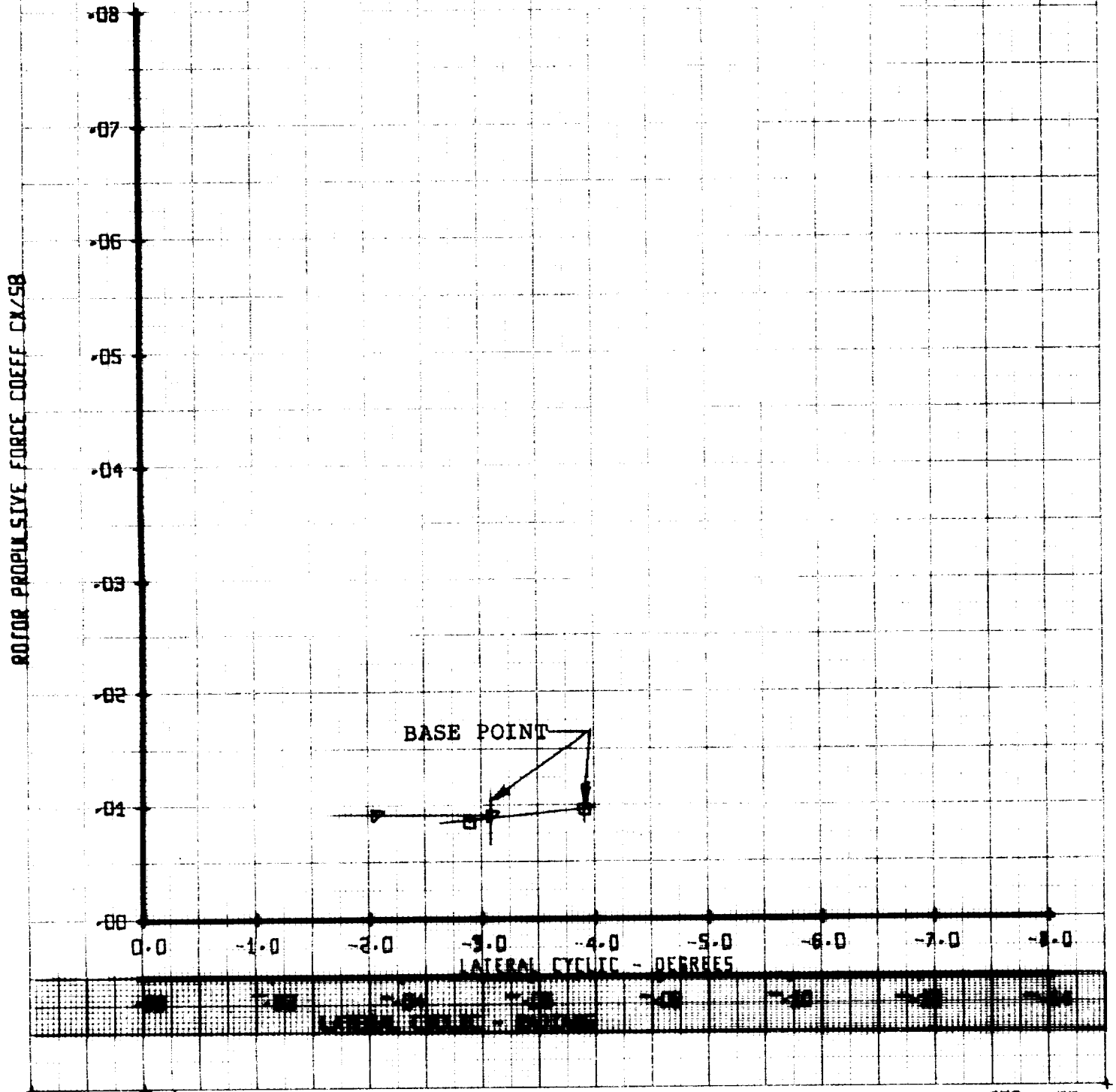


Figure C-231

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MI	X/0025B	CT/5B	VTUN
□	50	.53	.05	.102	328
△	50	.53	.05	.079	328

ROTOR POWER COEFFICIENT
VERSUS
LATERAL CYCLIC

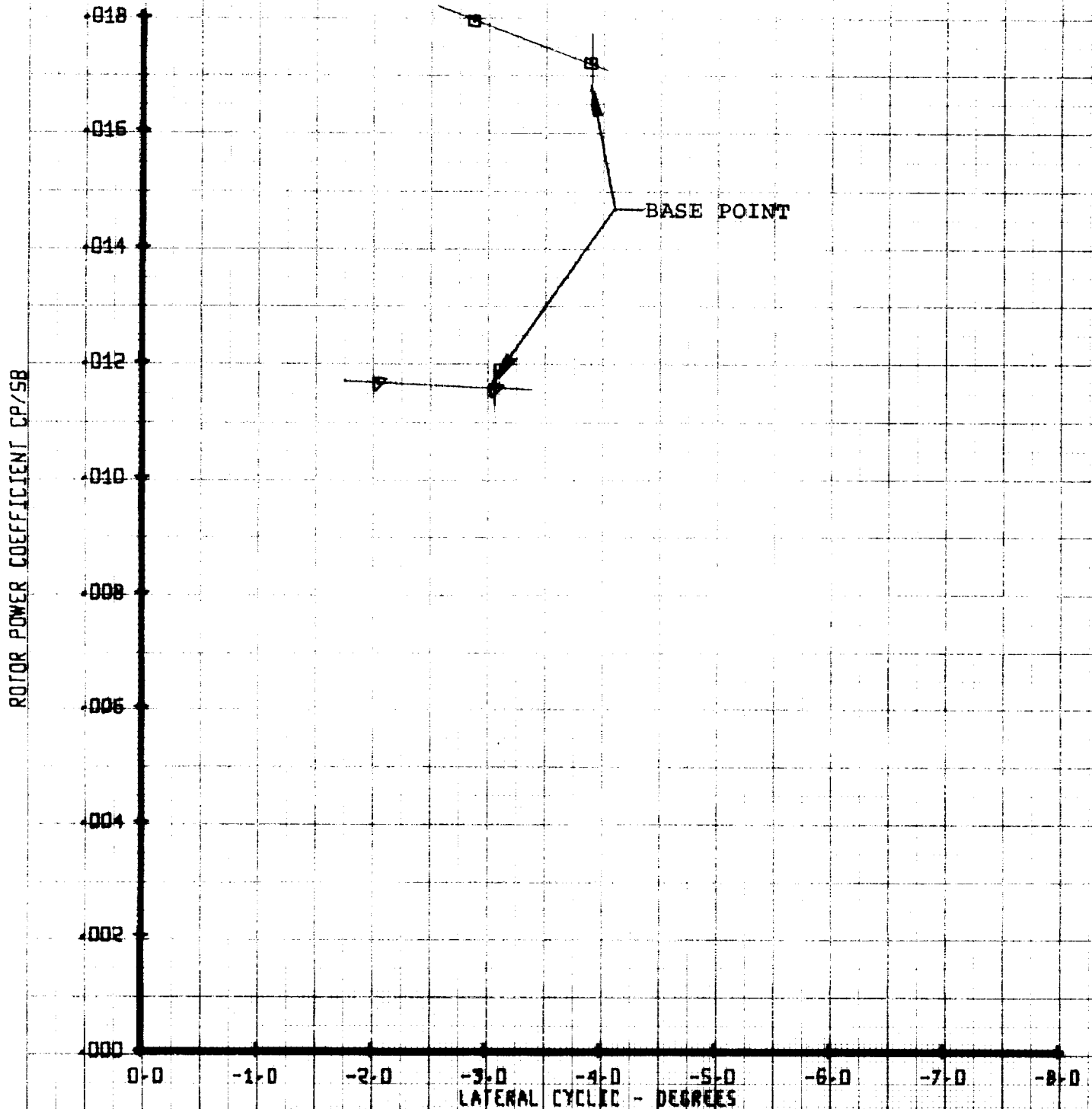


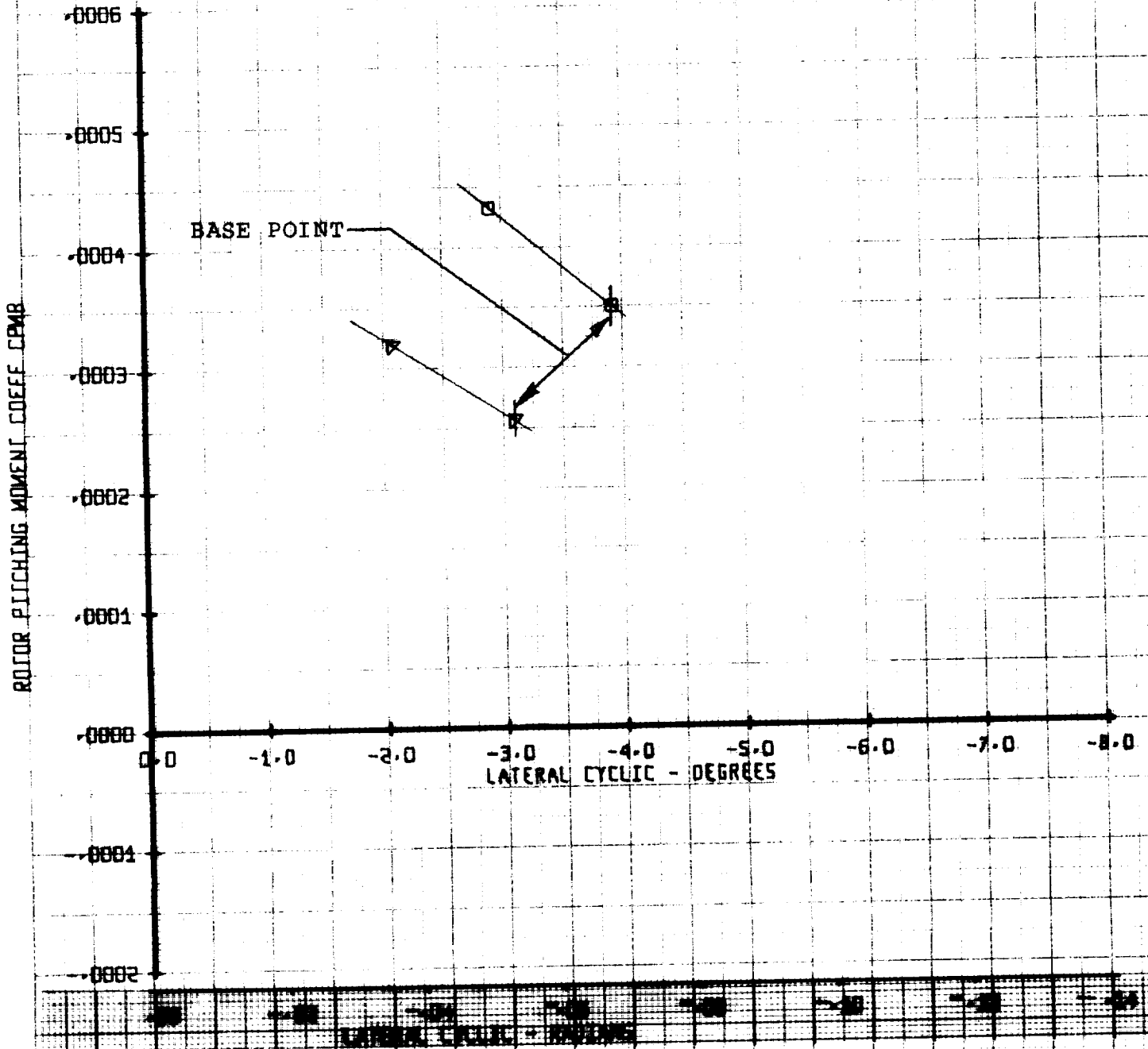
Figure 232

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/98	VIUN
50	50	.53	.05	.102	329
50	50	.53	.05	.079	329

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU' X/00258	CT'/58	VTUN
50	50	.53	.05	.102
70	50	.53	.05	.079

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LATERAL CYCLIC

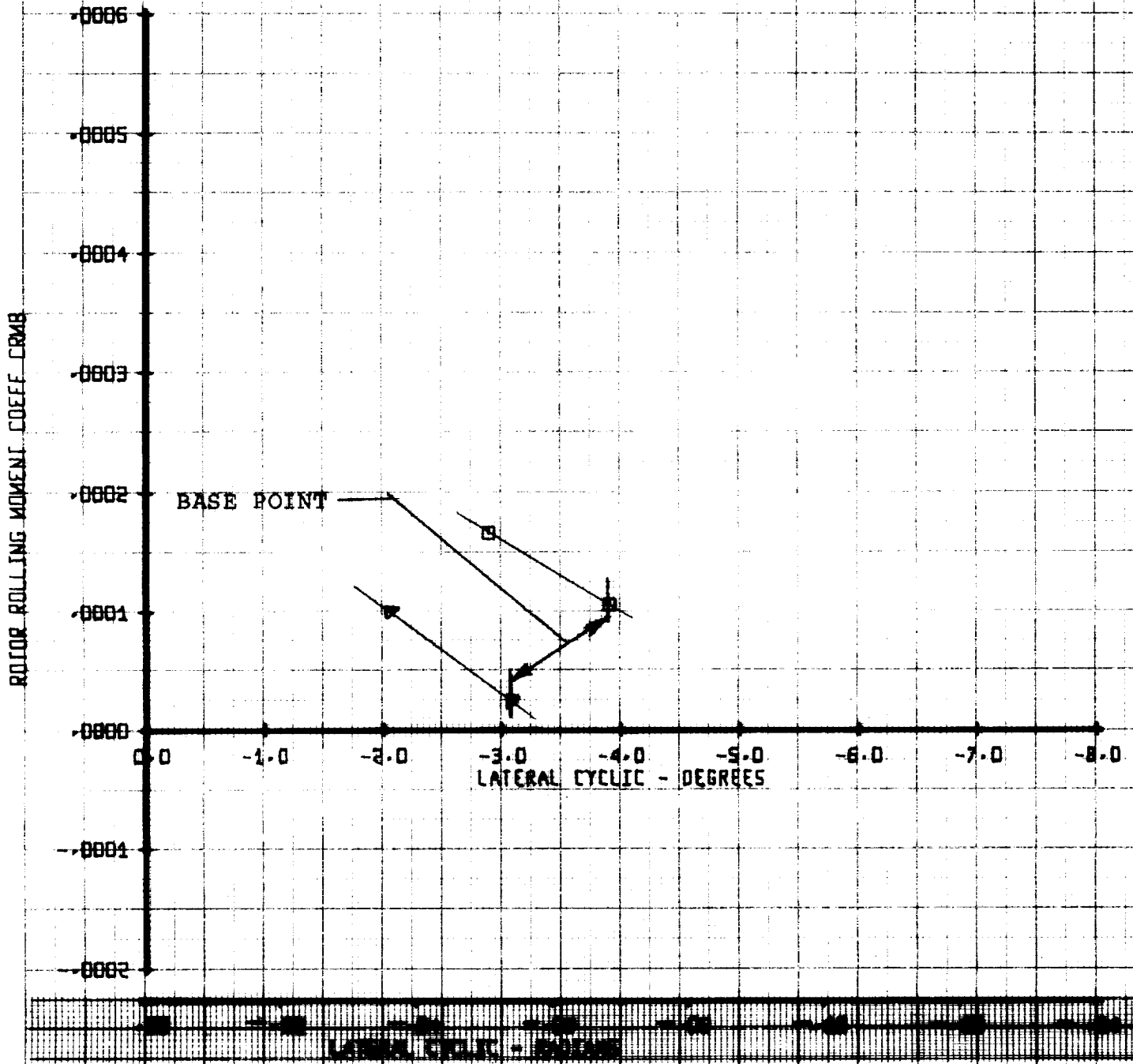


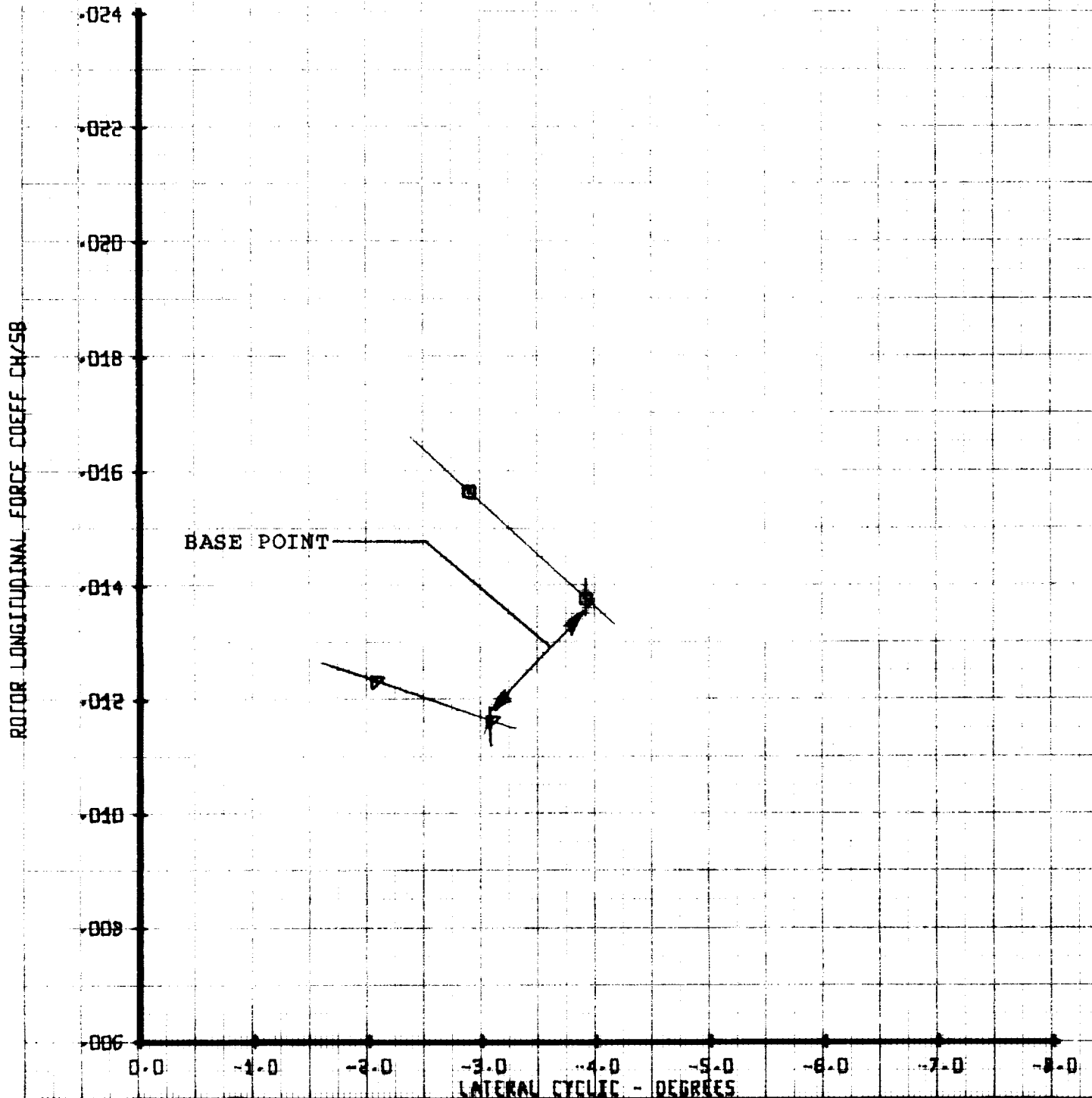
Figure C-234

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-42B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/CD258	CT/58	VTUN
50	50	.53	.05	.102	329
70	50	.53	.05	.079	329

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	VTUN
50	50	.58	.05	.102	329
50	50	.58	.05	.079	329

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LATERAL CYCLIC

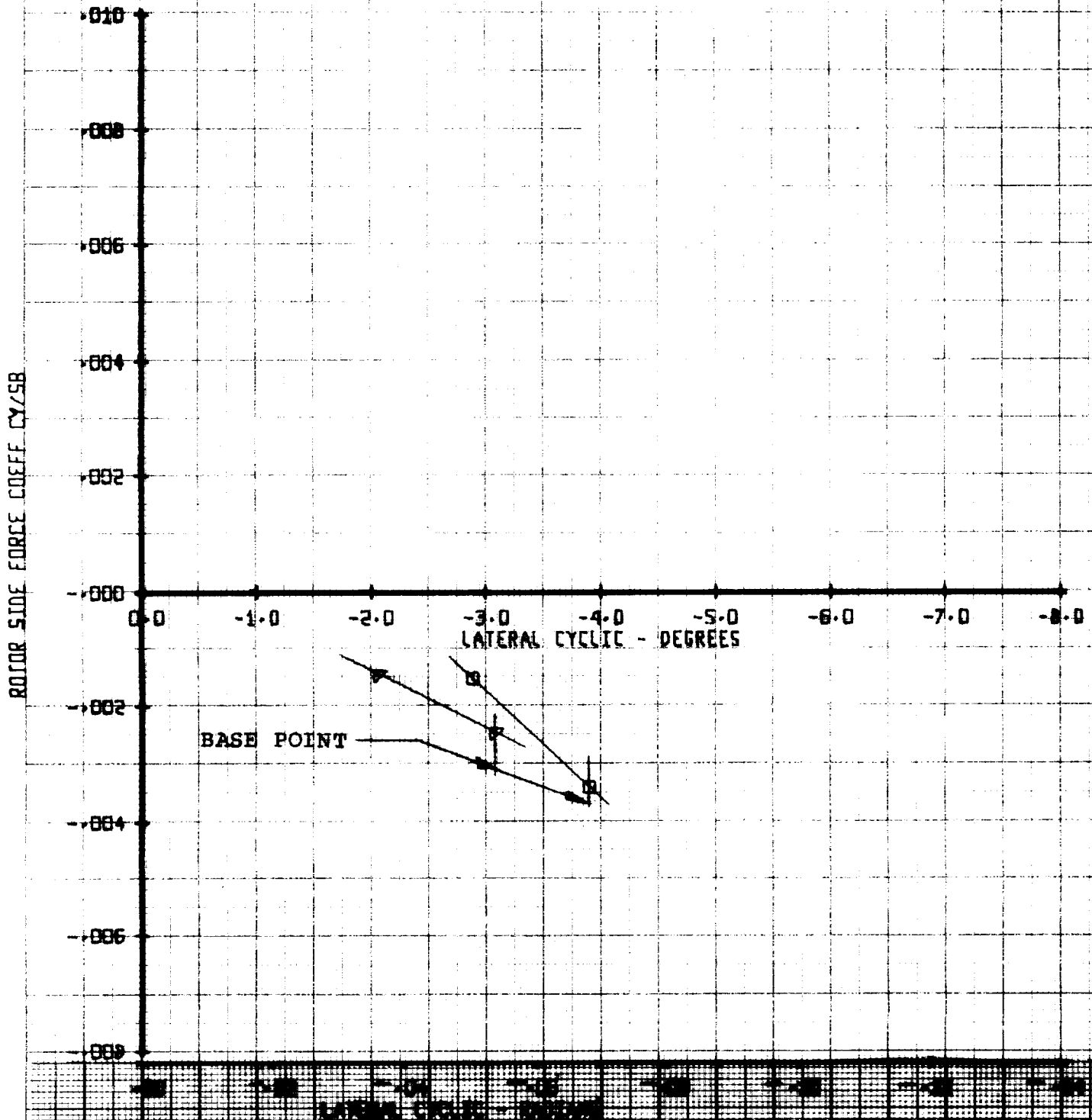


Figure C-236

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/DP258	CT'/98	VTUN
50	50	.53	.05	.102	329
50	50	.53	.05	.079	329

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LATERAL CYCLIC

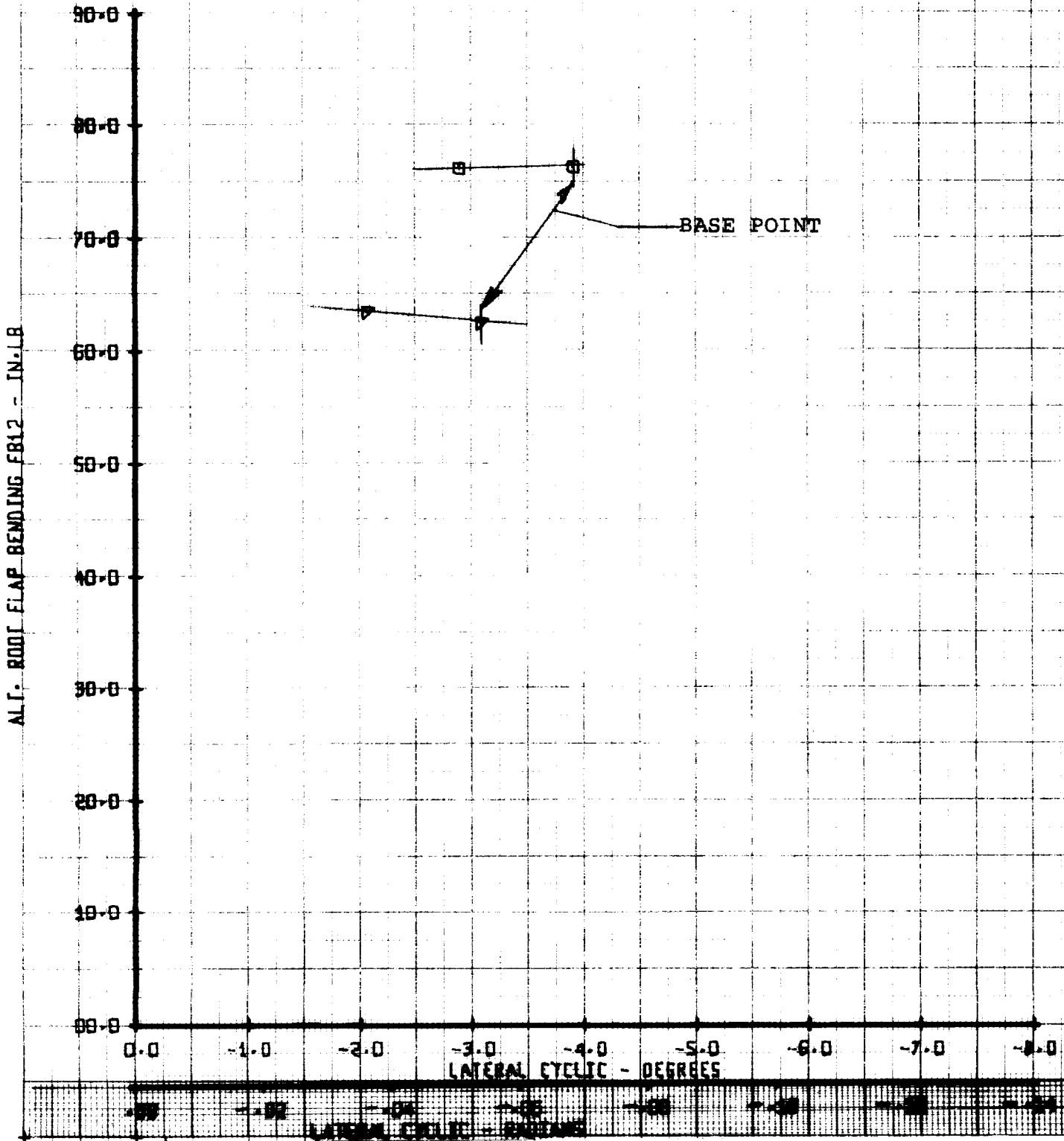


Figure C-237

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/98	VTUN
0	50	.53	.05	.102	329
7	50	.53	.05	.079	329

ALTERNATING ROOT CHORD BENDING CB12
VERSUS
LATERAL CYCLIC

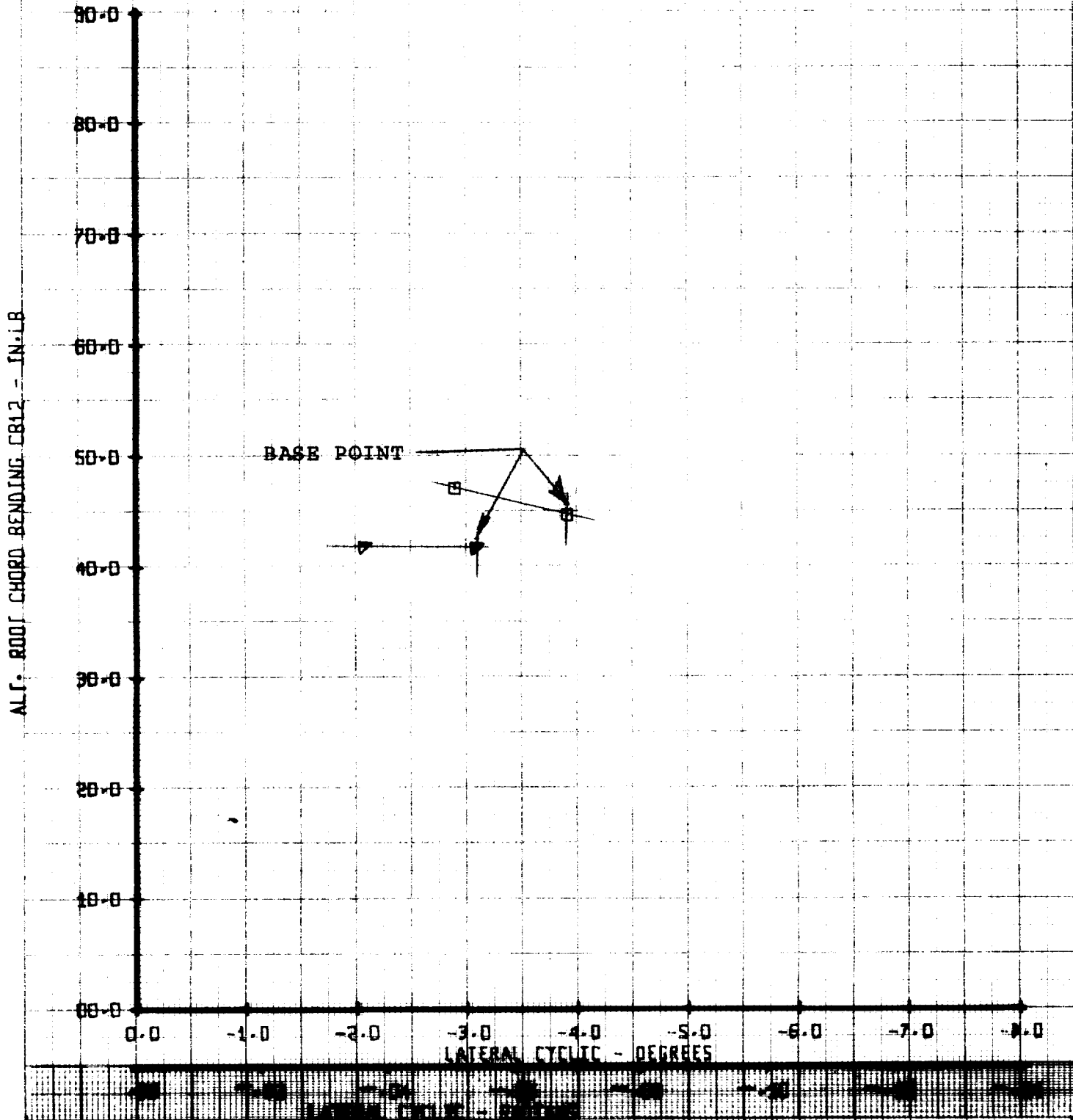


Figure C-238

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/OD258	CT/98	VTUN
50	50	.53	.05	.102	329
50	50	.53	.05	.079	329

ALTERNATING ROOT TORSION TB12
VERSUS
LATERAL CYCLIC

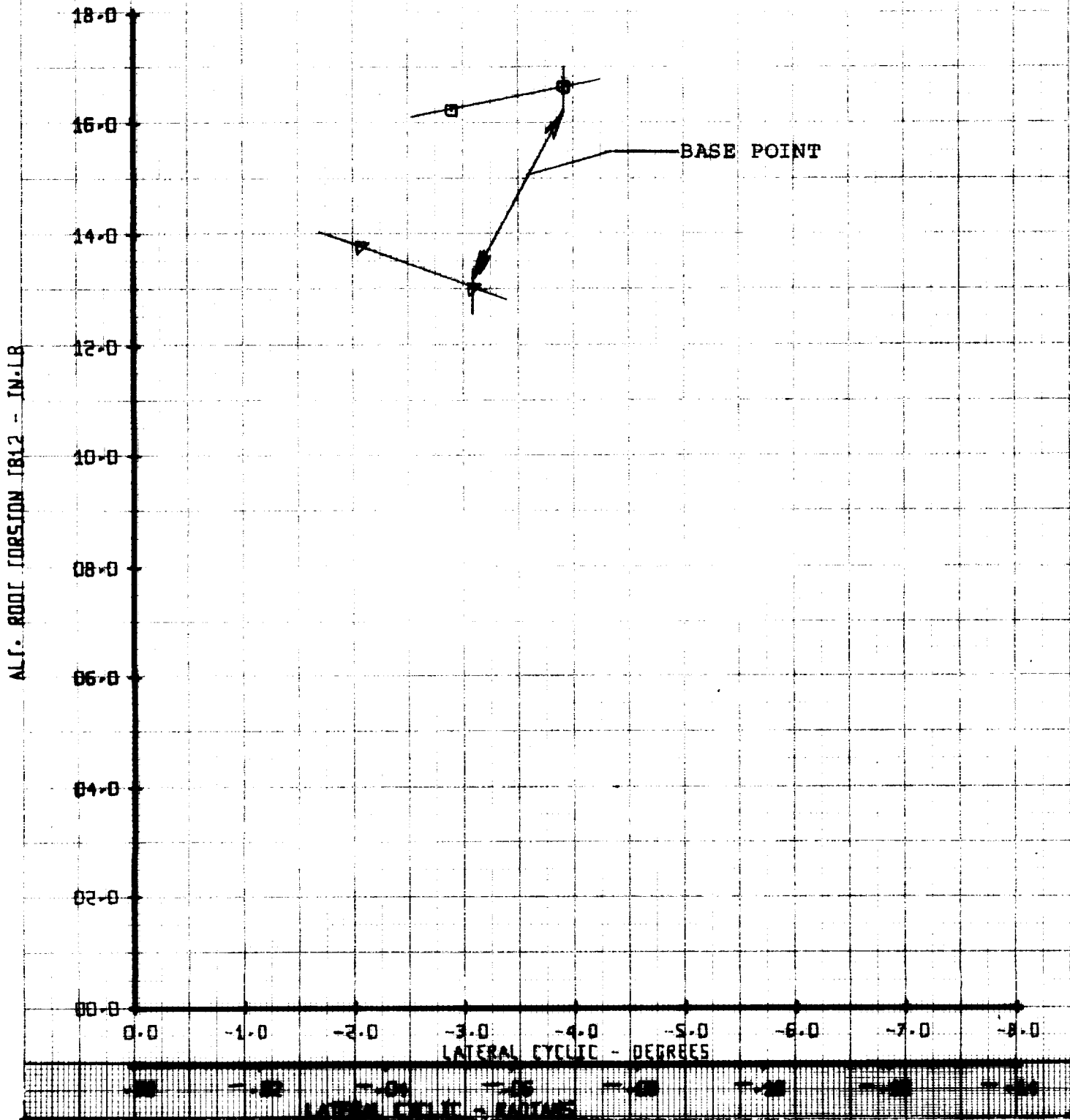


Figure C-239

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT'/58	YTLN
□	50	.58	.05	.102	329
△	50	.58	.05	.079	329

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

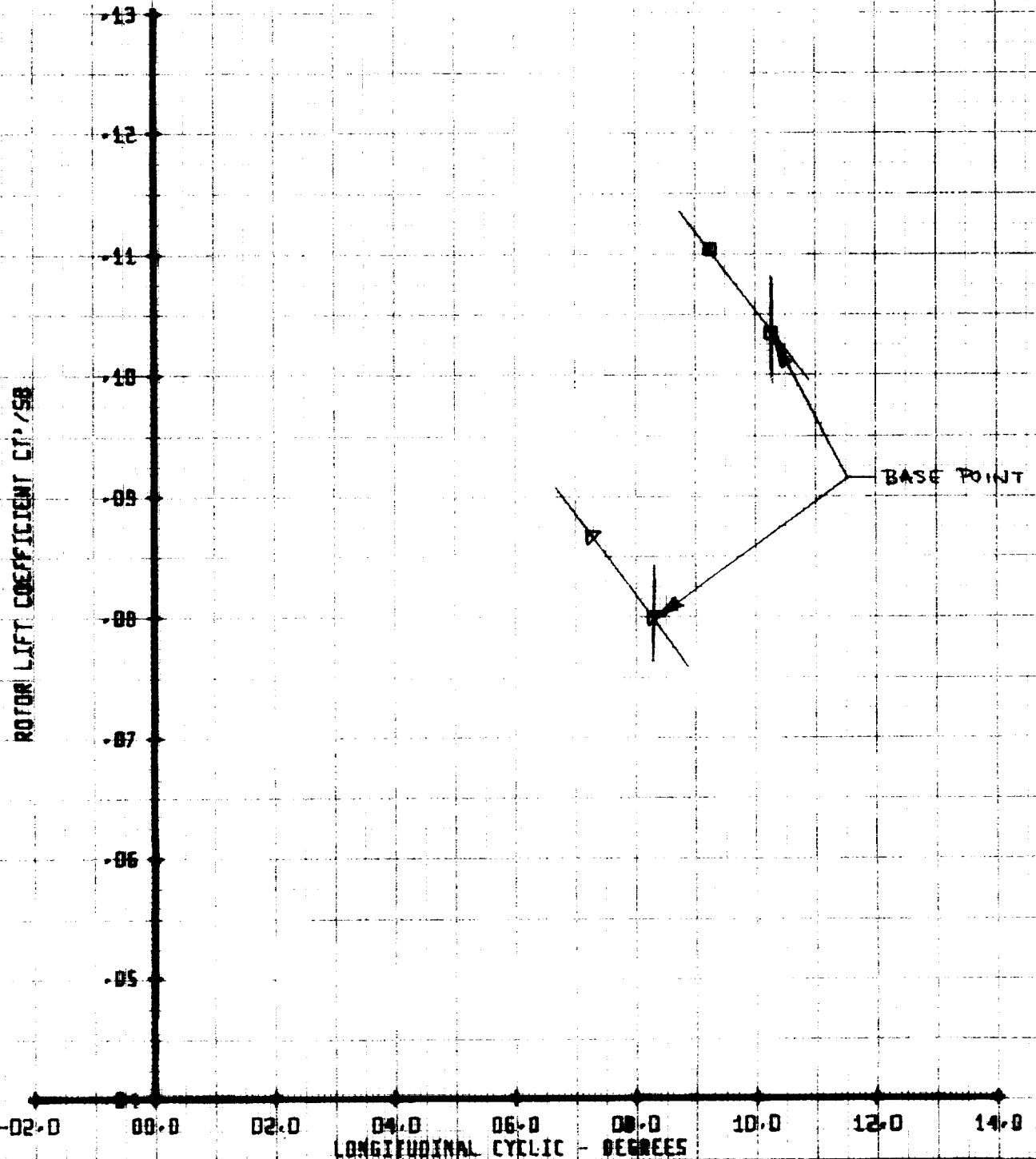


Figure C-240

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE OH-47B ROTOR
 CONTROL POWER TESTING

LEGEND

SYM	RUN	MU'	X/00258	CT'/98	VTUN
50	50	.58	.05	.102	329
4	50	.58	.05	.079	329

ROTOR PROPULSIVE FORCE COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

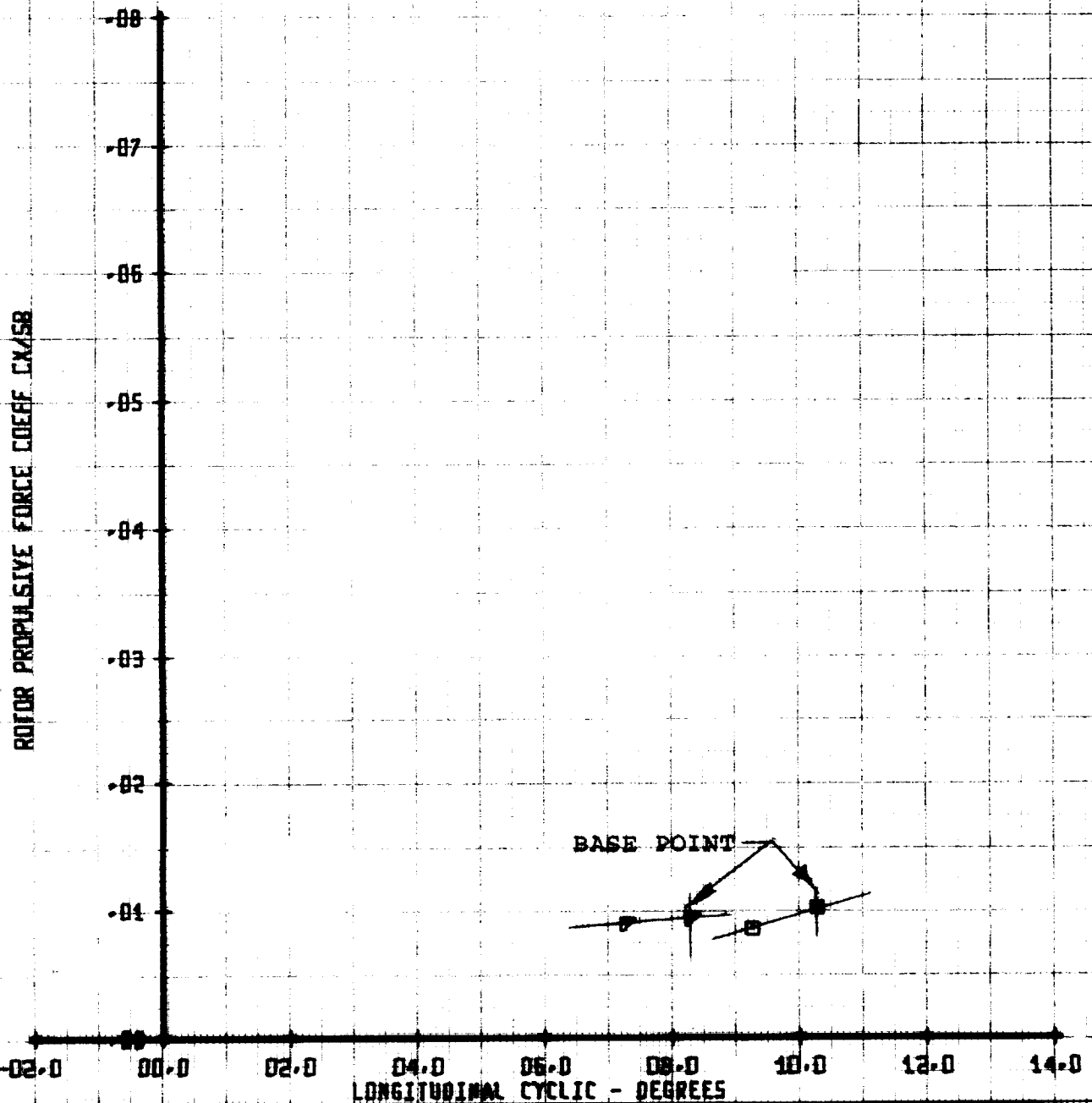


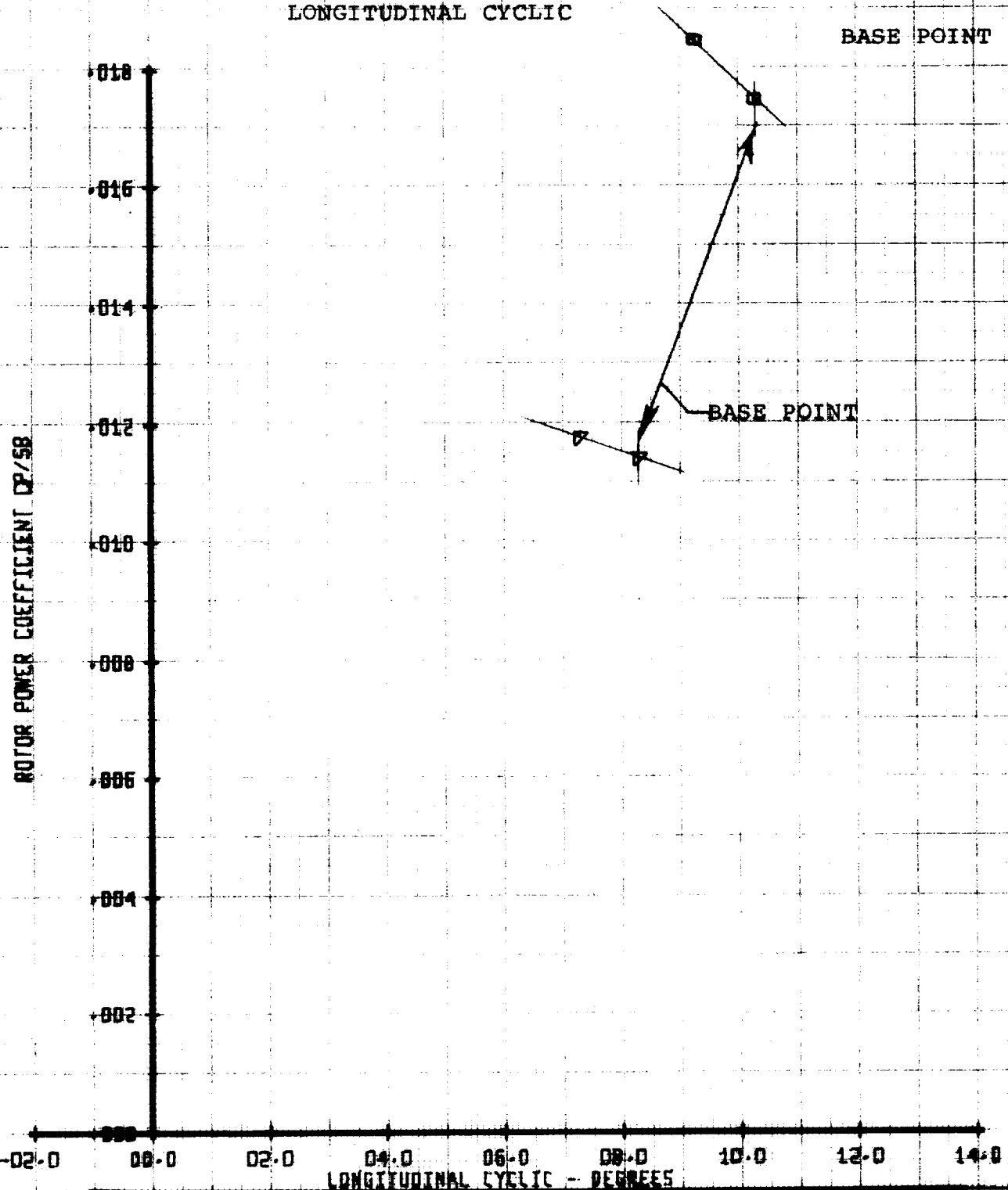
Figure C-241

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/DD25B	CT/5B	VTUN
0	50	.58	.05	.102	329
7	50	.58	.05	.079	329

ROTOR POWER COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



SET 33
BWWT 187

Figure C-242

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	YTUN
0	50	.58	.05	.102	329
Δ	50	.58	.05	.079	329

ROTOR PITCHING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

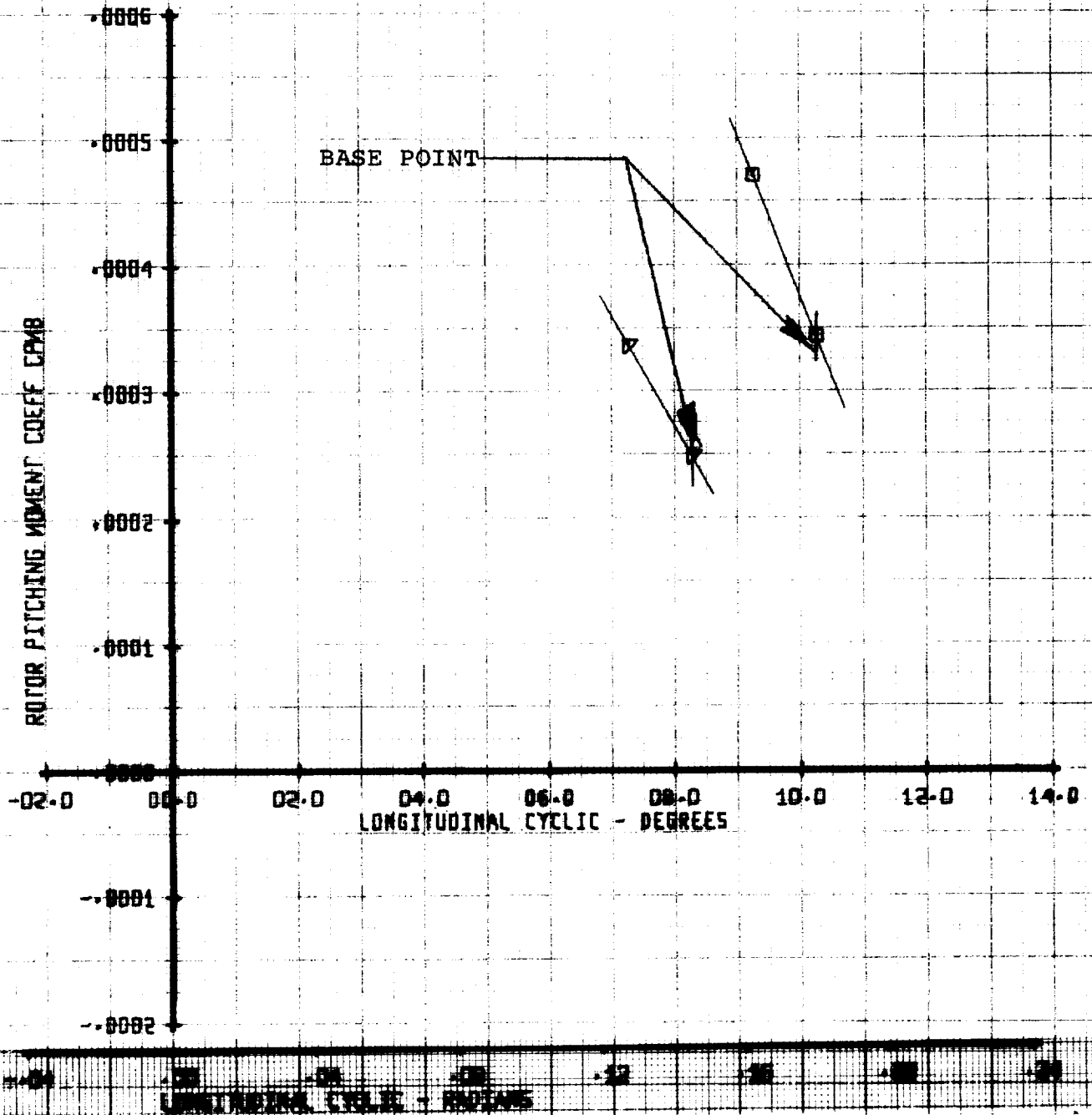


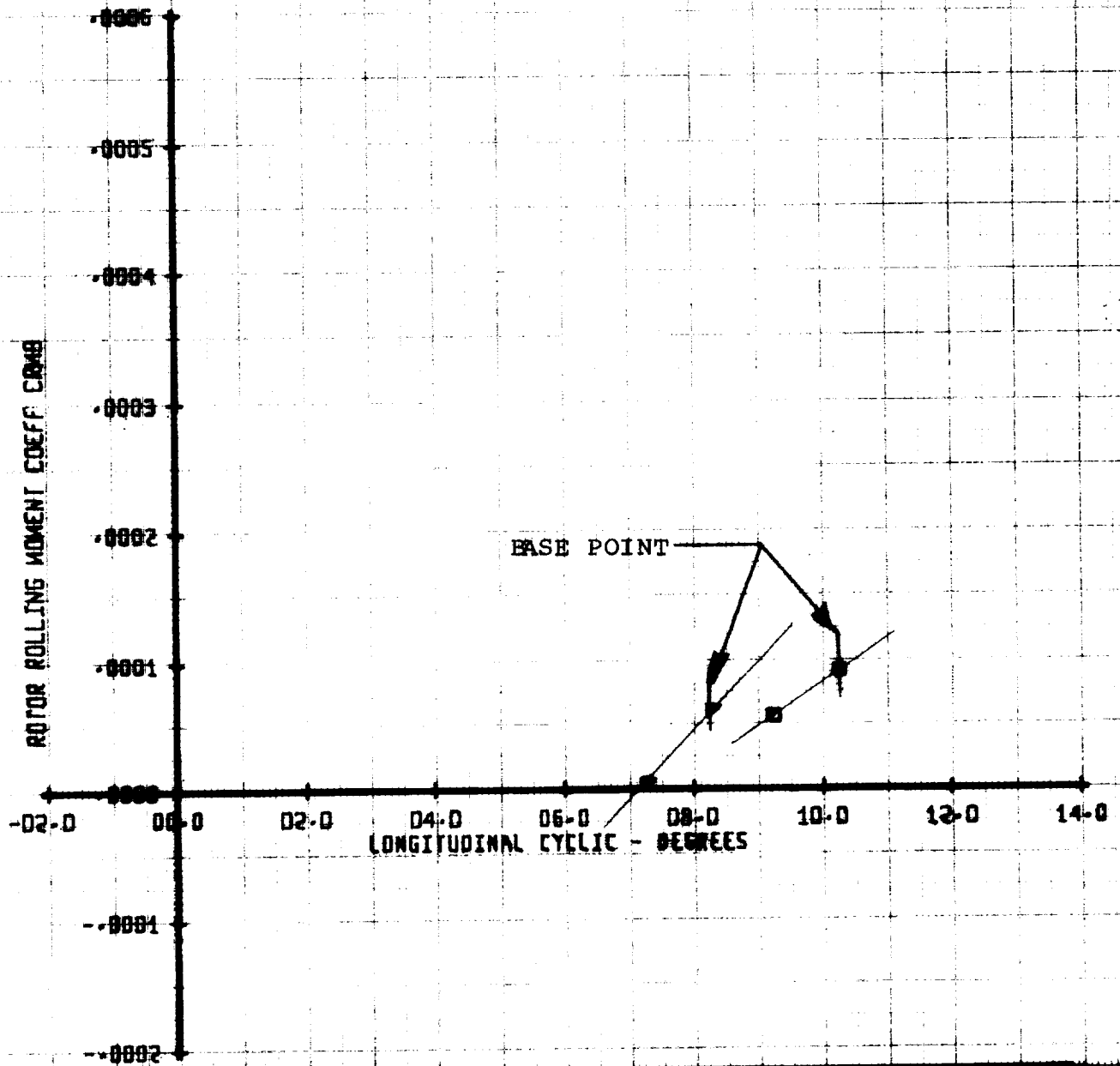
Figure C-243

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00250	CT/50	VTUN
B	50	.59	.05	.102	328
P	50	.59	.05	.079	328

ROTOR ROLLING MOMENT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	ML' X/100258	CI' / SB	VIUN
50	50	.53	.05	.102
50	50	.53	.05	.079

ROTOR LONGITUDINAL FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

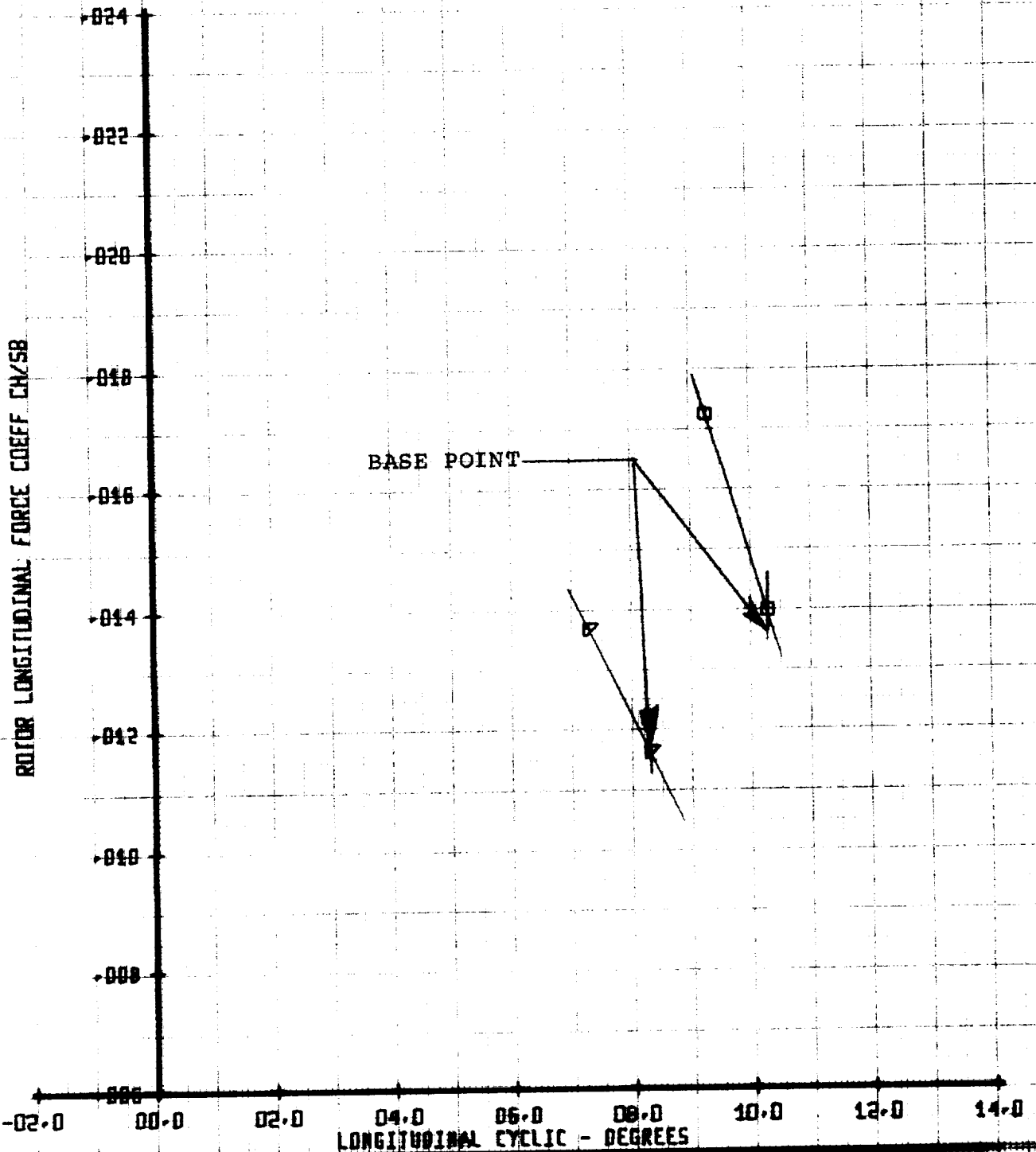


Figure C-245

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

S/N	RUN	MU	X/OD258	CI/58	VTUN
0	50	.53	.05	.102	329
1	50	.53	.05	.079	329

ROTOR SIDE FORCE COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

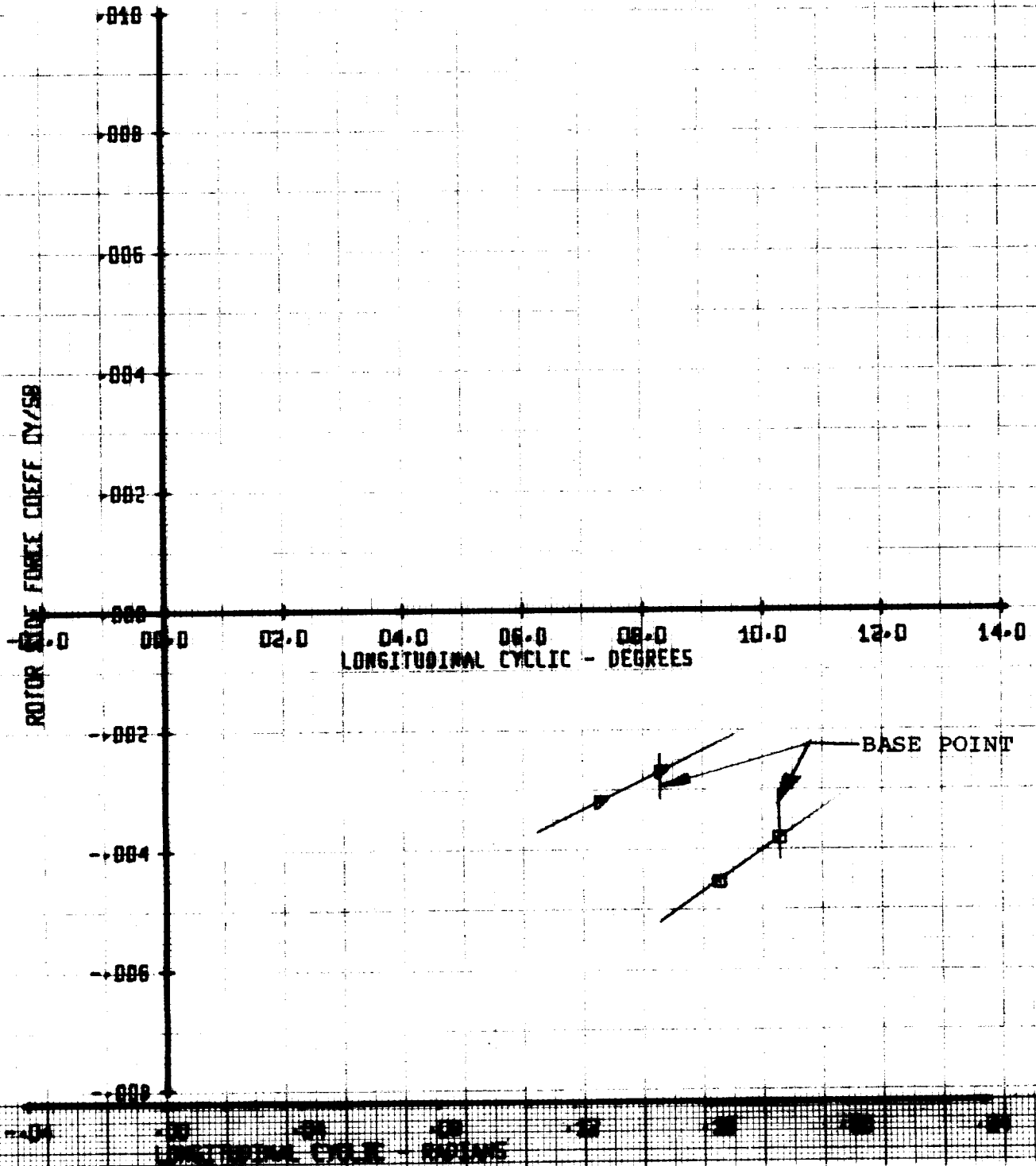


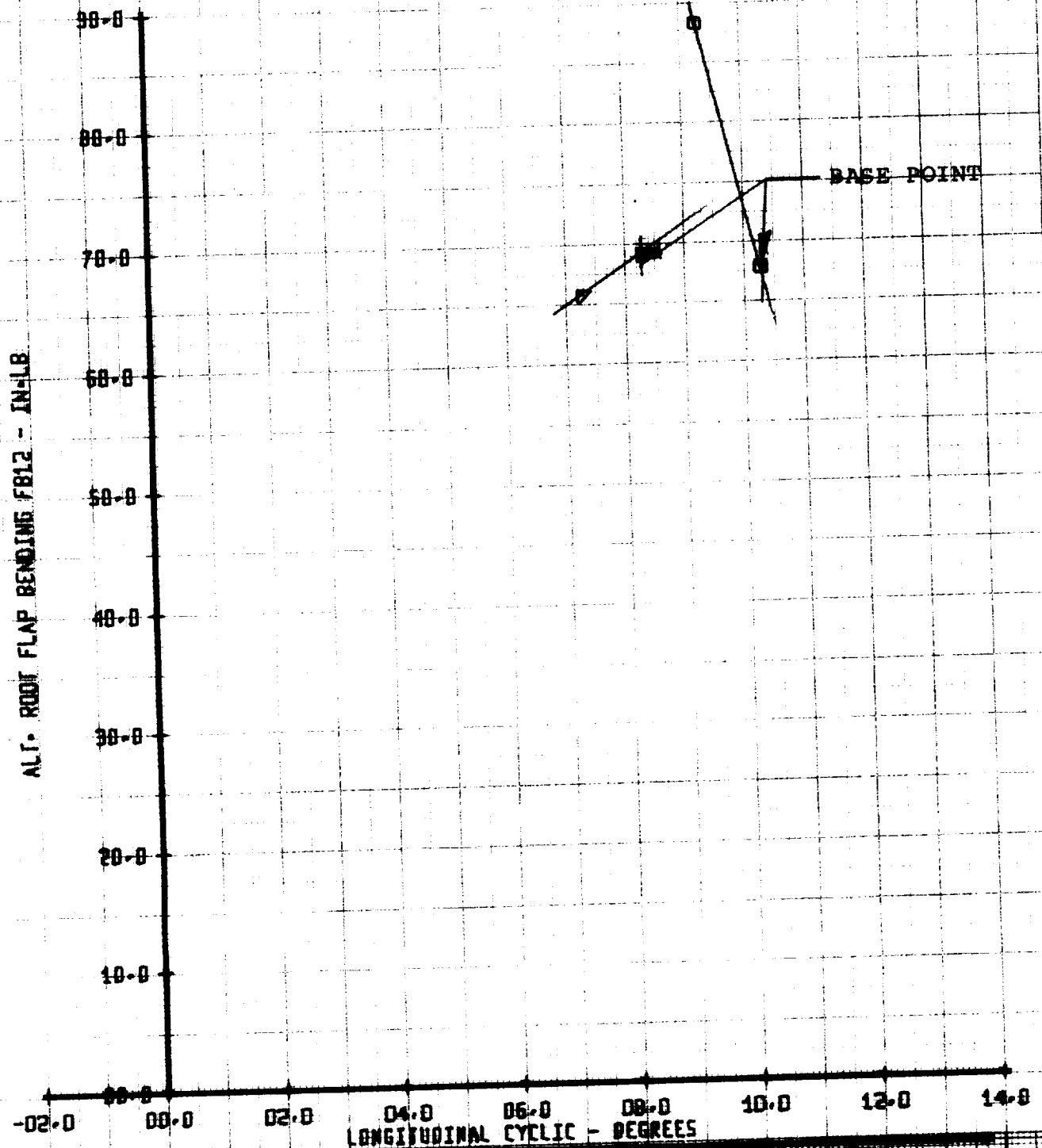
Figure C-246

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MU	X/00258	CT/58	YTUN
50	50	.58	.05	.102	329
50	50	.58	.05	.079	329

ALTERNATING ROOT FLAP BENDING FB12
VERSUS
LONGITUDINAL CYCLIC



SET 33
BVWT 187

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE OH-47B ROTOR
CONTROL POWER TESTING

LEGEND

SYM	RUN	MJ'	1/00258	CT'/98	VTUN
0	50	.53	.05	.102	329
1	50	.53	.05	.079	329

ALTERNATING ROOT CHORD BENDING CB12
versus
LONGITUDINAL CYCLIC

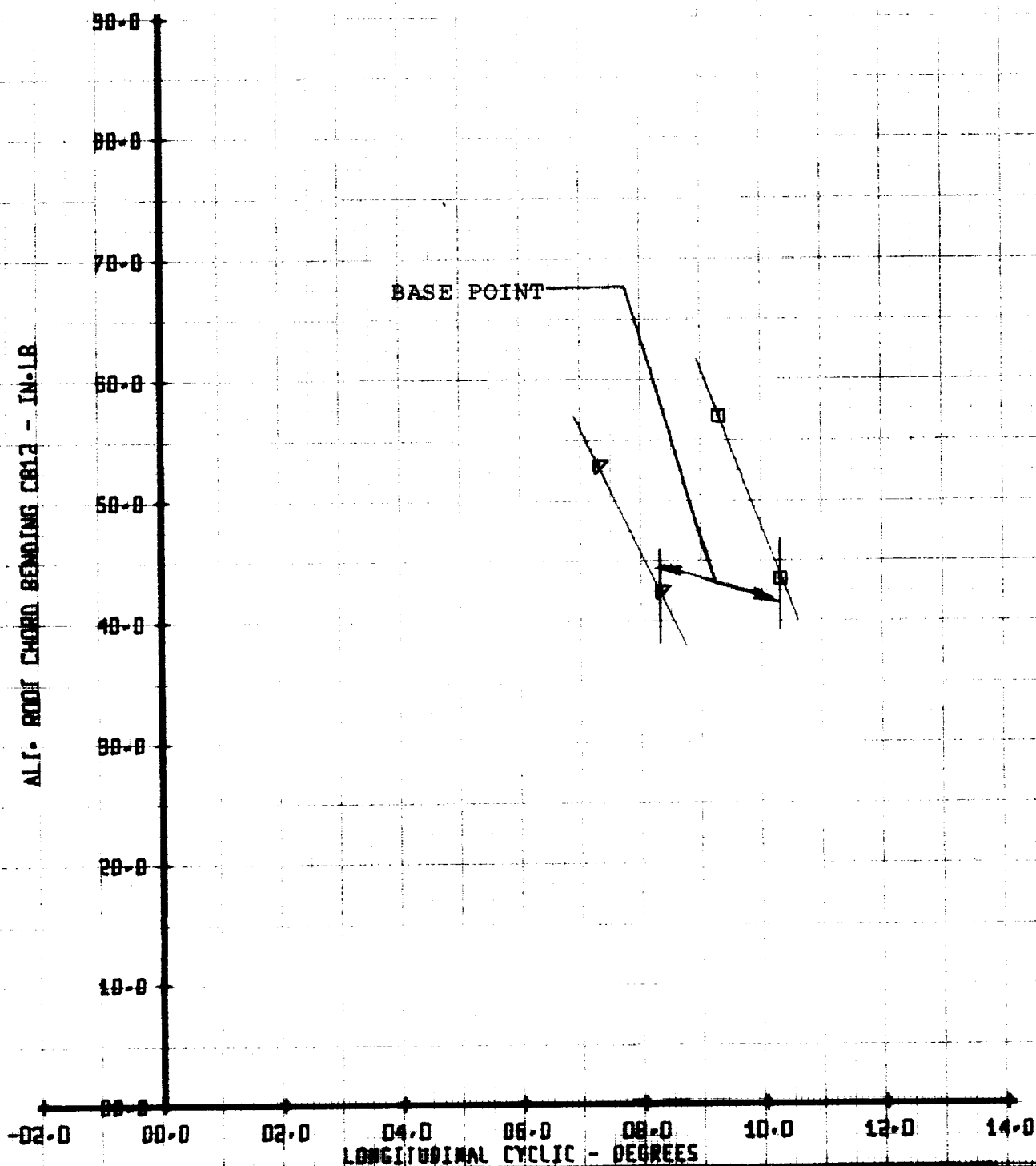


Figure C-248

LIFT-PROPULSIVE FORCE LIMIT TEST

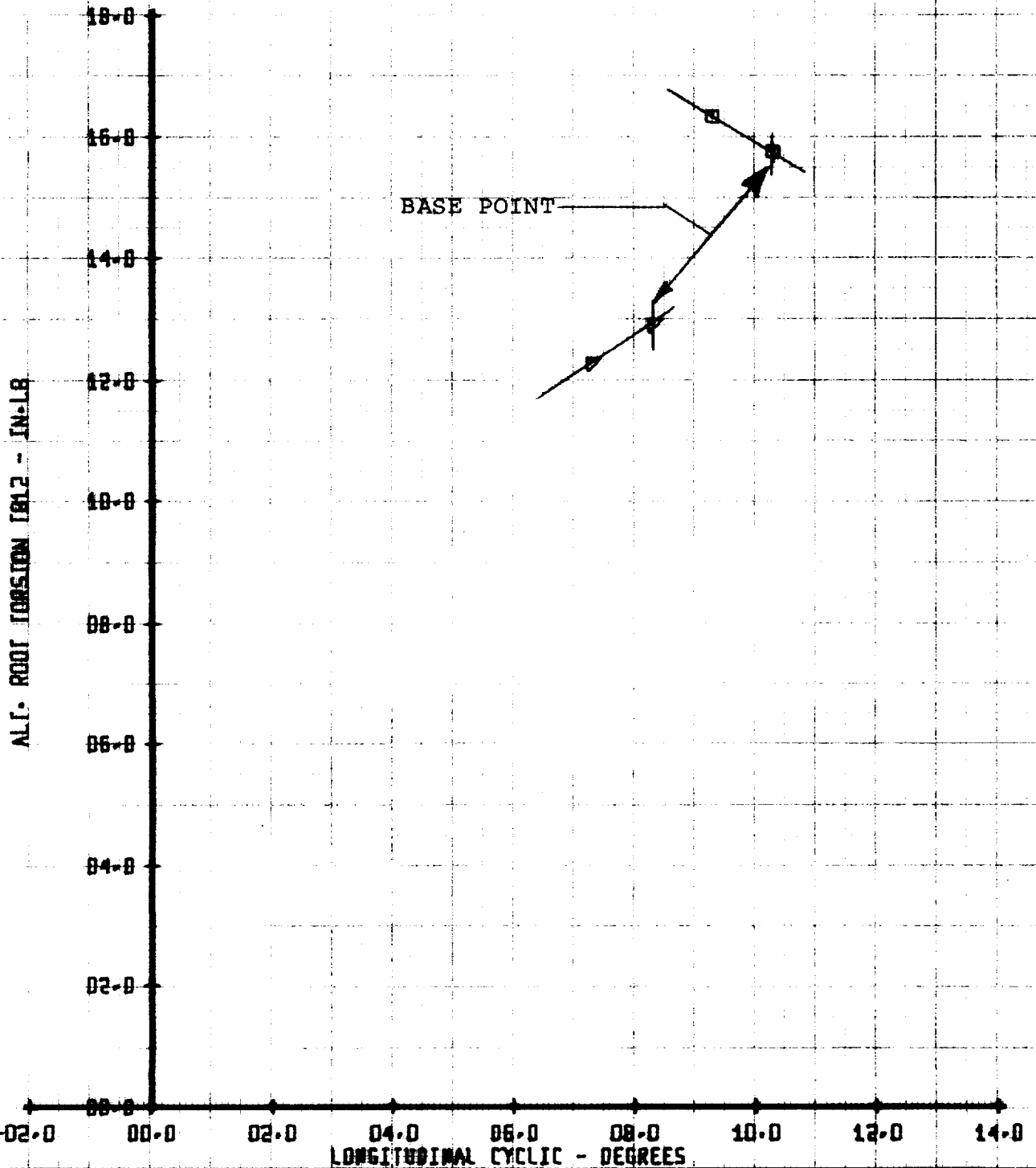
1/10 SCALE OH-47B ROTOR

CONTROL POWER TESTING

LEGEND

SYM	RUN	MA	1/00258	CT/98	VTUN
0	50	.53	.05	.102	329
9	50	.53	.05	.079	329

ALTERNATING ROOT TORSION TB12
VERSUS
LONGITUDINAL CYCLIC



D. Performance Summary

Performance data obtained during the definition of the lift limit is shown in Appendix A at individual advance ratio for a variation of propulsive force or for a limited range of advance ratios for one propulsive force level. This section presents a summary of rotor performance, the rotor and control positions required and the alternating blade root torsion load produced. This data is presented for one level of propulsive force coefficient, $X/qd^2\sigma = 0.05$, at the basic tip speed of 620 ft/sec and the reduced tip speed of 570 ft/sec. During the testing two distinct levels of performance were observed; one without stall at the retreating tip and the other with stall present throughout the sweep in lift coefficient. Both sets of performance are included to delineate the two levels of performance and specify which runs are in each category.

The test data obtained for each of these test runs of Appendix A have been combined to show the effect of advance ratio only. The combinations, identified as plot sets are defined in Table D-1 and are marked on the bottom of each sheet. Within each plot set are a series of graphs presenting the variation of the major components of measured data with rotor lift coefficient. The sequence of these graphs are as follows:

- Rotor Lift Coefficient versus Shaft Angle of Attack
- Rotor Lift Coefficient versus Collective Pitch
- Rotor Lift Coefficient versus Longitudinal Cyclic
- Rotor Lift Coefficient versus Lateral Cyclic
- Rotor Lift Coefficient versus Rotor Power Coefficient
- Rotor Lift Coefficient versus Alternating Root Torsion TB12

TABLE D-1 DATA PLOTTING SUMMARY FOR PERFORMANCE SUMMARY

PLOT SET	RUN NO.	ROTOR TIP SPEED V_T	ADVANCE RATIO μ	ROTOR LIFT COEFF. C_L/σ	ROTOR PROPULSIVE FORCE COEFF. $X/qd^2\sigma$	TUNNEL SPEED V	COMMENTS
44	23	620 FPS	0	Range	.05	0	Performance at baseline tip speed
	25		.10			62 FPS	
	27		.20			124 FPS	
	30		.40			248 FPS	
	36		.45			279 FPS	
	39		.50			310 FPS	
	50		.53			329 FPS	
	228		.57			353 FPS	
	229		.61			378 FPS	
46	256	570 FPS	.40	Range	.05	228 FPS	Performance at reduced tip speed
	255		.45			256 FPS	
	254		.50			285 FPS	
	257		.53			302 FPS	
	258		.57			325 FPS	
	259		.61			348 FPS	
	260		.64			368 FPS	
43	23	620 FPS	0	Range	.05	0	Performance at baseline tip speed with tip stall throughout C_L/σ sweep
	25		.10			65 FPS	
	28		.20			124 FPS	
	29		.30			186 FPS	
	227		.45			279 FPS	
	225		.50			310 FPS	
	224		.53			328 FPS	
	273		Range			Range	
	274		Range			Range	
45	250	570 FPS	.40	Range	.05	228 FPS	Performance at reduced tip speed with tip stall throughout C_L/σ sweep
	251		.45			256 FPS	
	252		.50			285 FPS	
	253		.53			302 FPS	

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CM47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MU'	X/00258	VTUN
□	23	0	.05	0
△	25	.10	.05	62
▽	27	.20	.05	124
◇	30	.40	.05	249
+	36	.45	.05	279
○	39	.50	.05	310
△	50	.53	.05	329
▽	228	.57	.05	353
◇	229	.61	.05	378

ROTOR LIFT COEFFICIENT
VERSUS
SHAFT ANGLE OF ATTACK

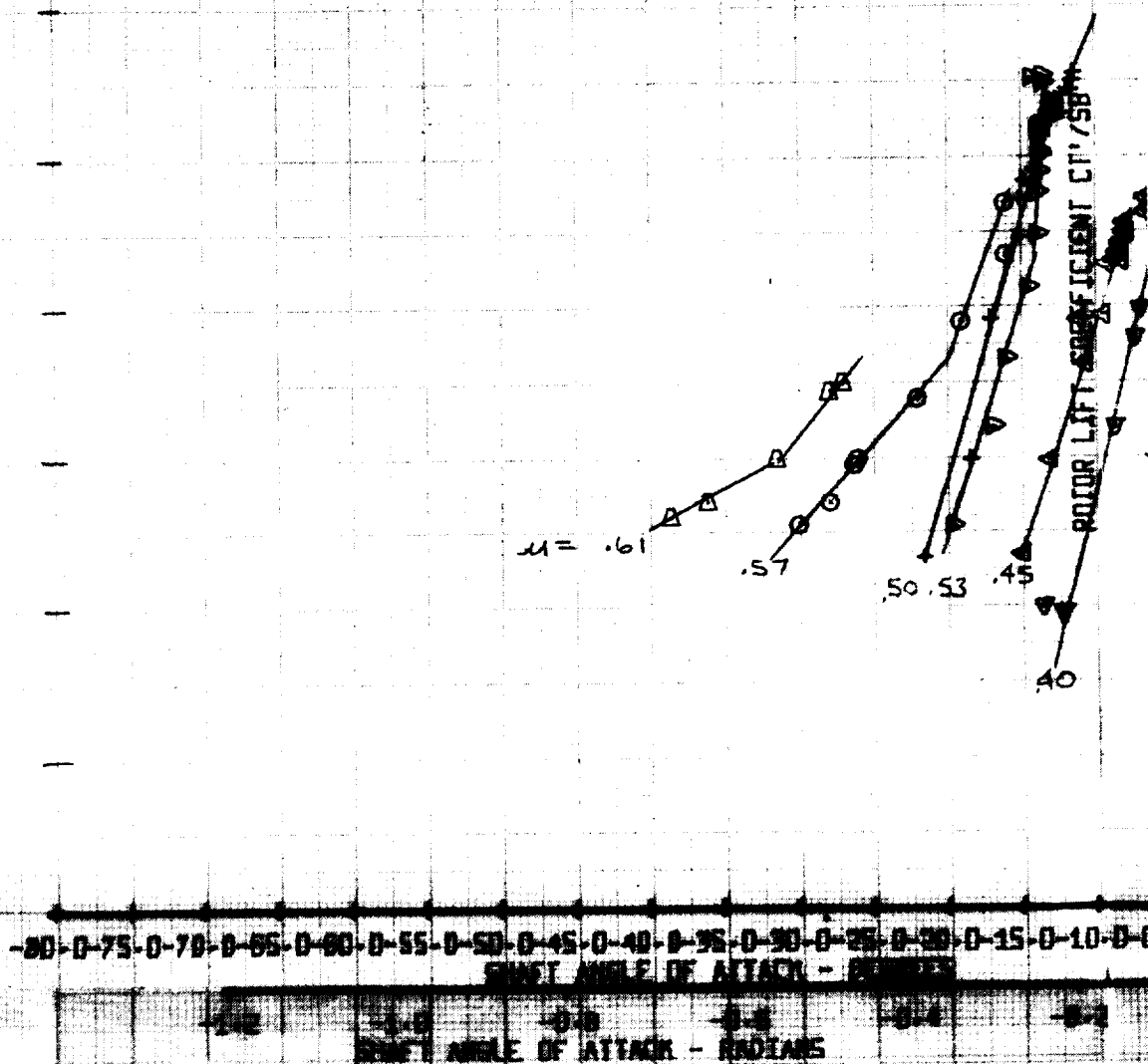
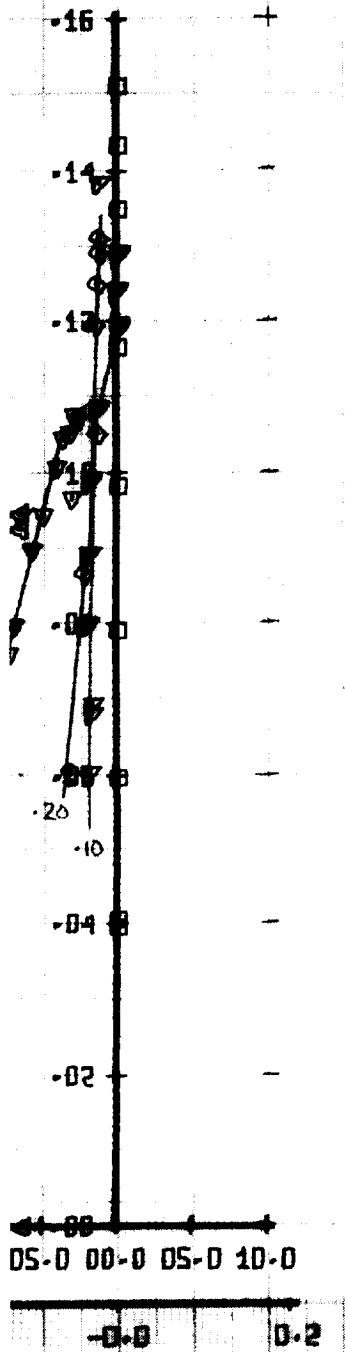


Figure D-1



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MU'	X/00258	VTUN
□	23	0	.05	0
△	25	.10	.05	62
◇	27	.20	.05	124
▽	30	.40	.05	248
+	36	.45	.05	279
○	39	.50	.05	310
△	50	.53	.05	329
○	228	.57	.05	353
△	229	.61	.05	376

ROTOR LIFT COEFFICIENT
VERSUS
COLLECTIVE PITCH

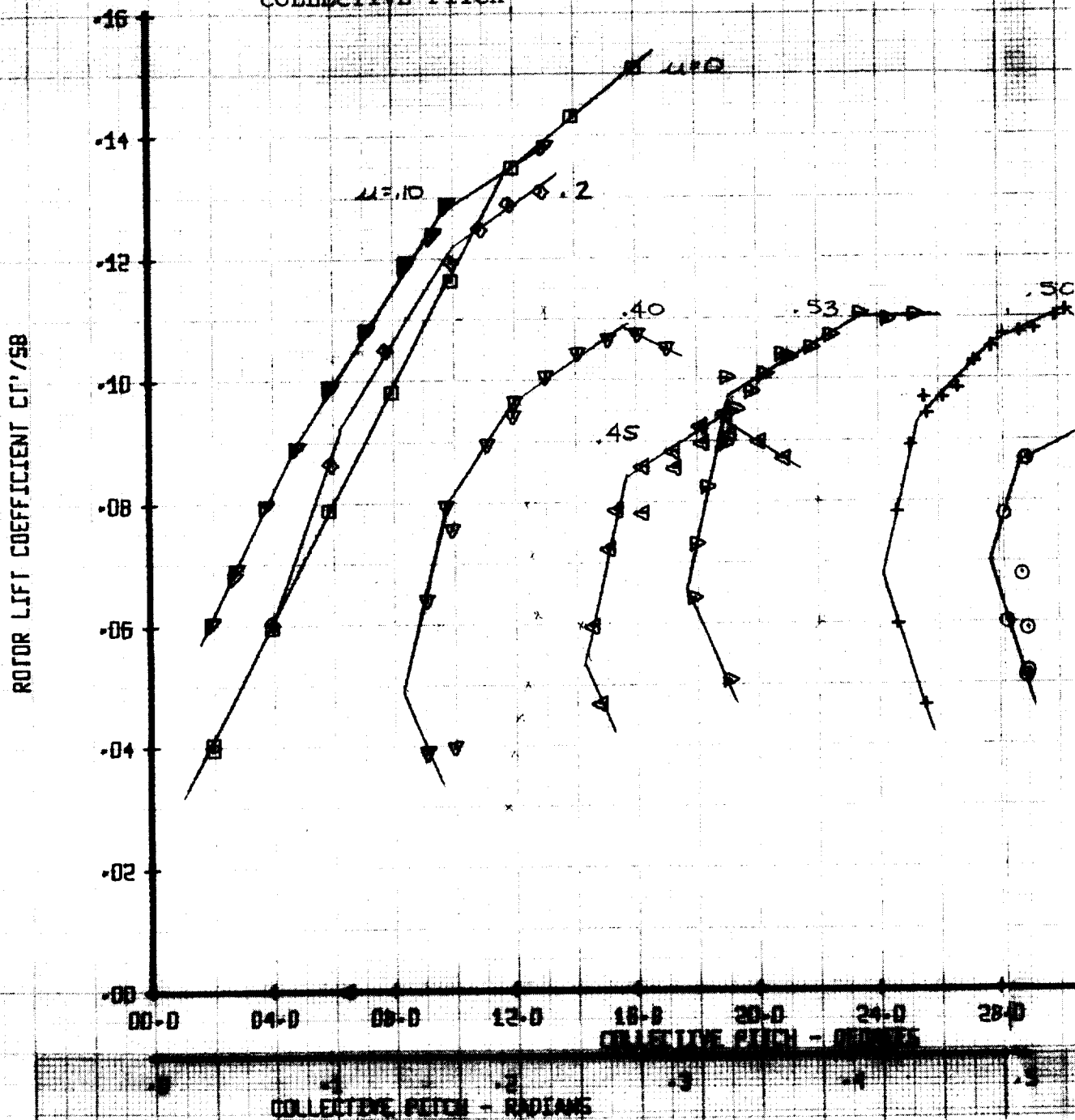
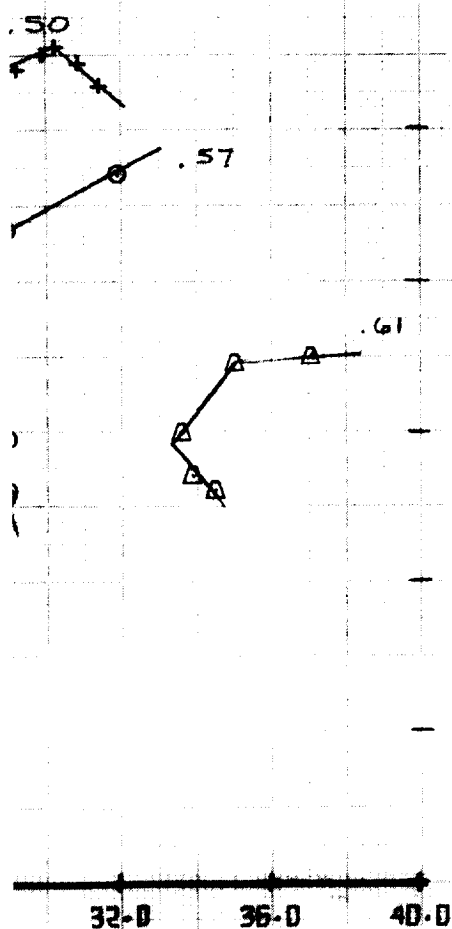


Figure D-2



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MU'	X/OD258	VTUN
□	23	0	.05	0
◇	25	.10	.05	62
▽	27	.20	.05	124
△	30	.40	.05	240
+	36	.45	.05	279
○	39	.50	.05	310
△	50	.53	.05	329
○	228	.57	.05	353
△	229	.61	.05	376

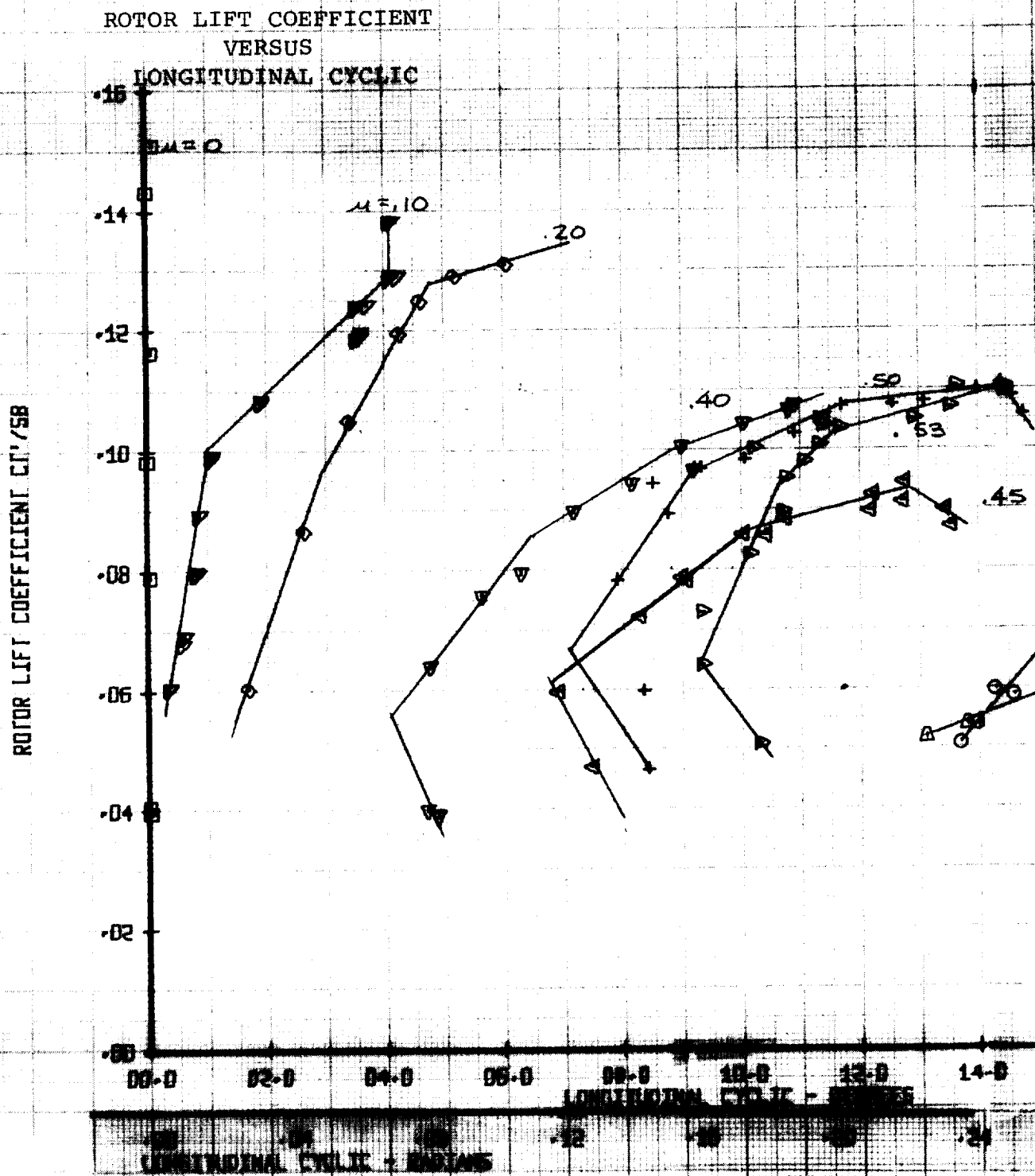
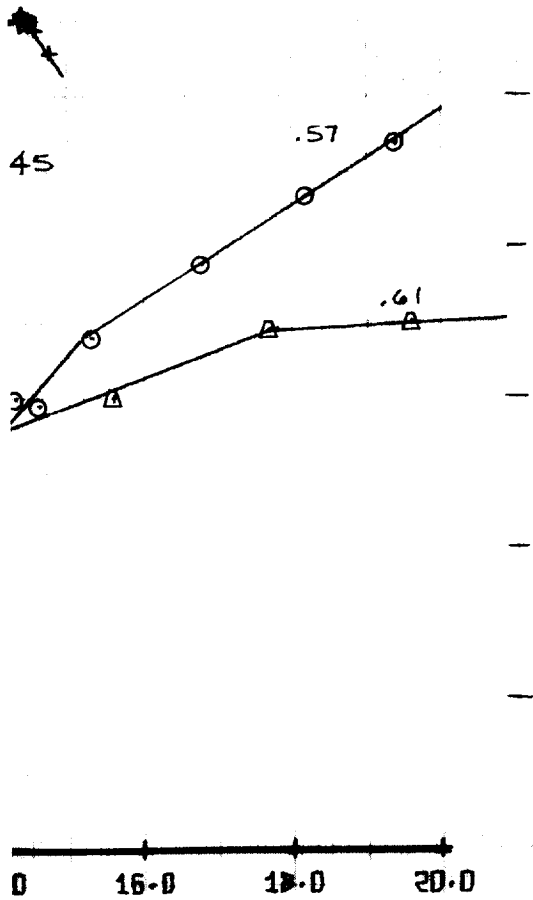


Figure D-3



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MU'	X/00258	VTUN
○	23	0	.05	0
□	25	.10	.05	62
△	27	.20	.05	124
▽	30	.40	.05	248
+	36	.45	.05	279
×	39	.50	.05	310
●	50	.53	.05	329
○	228	.57	.05	353
△	229	.61	.05	378

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC

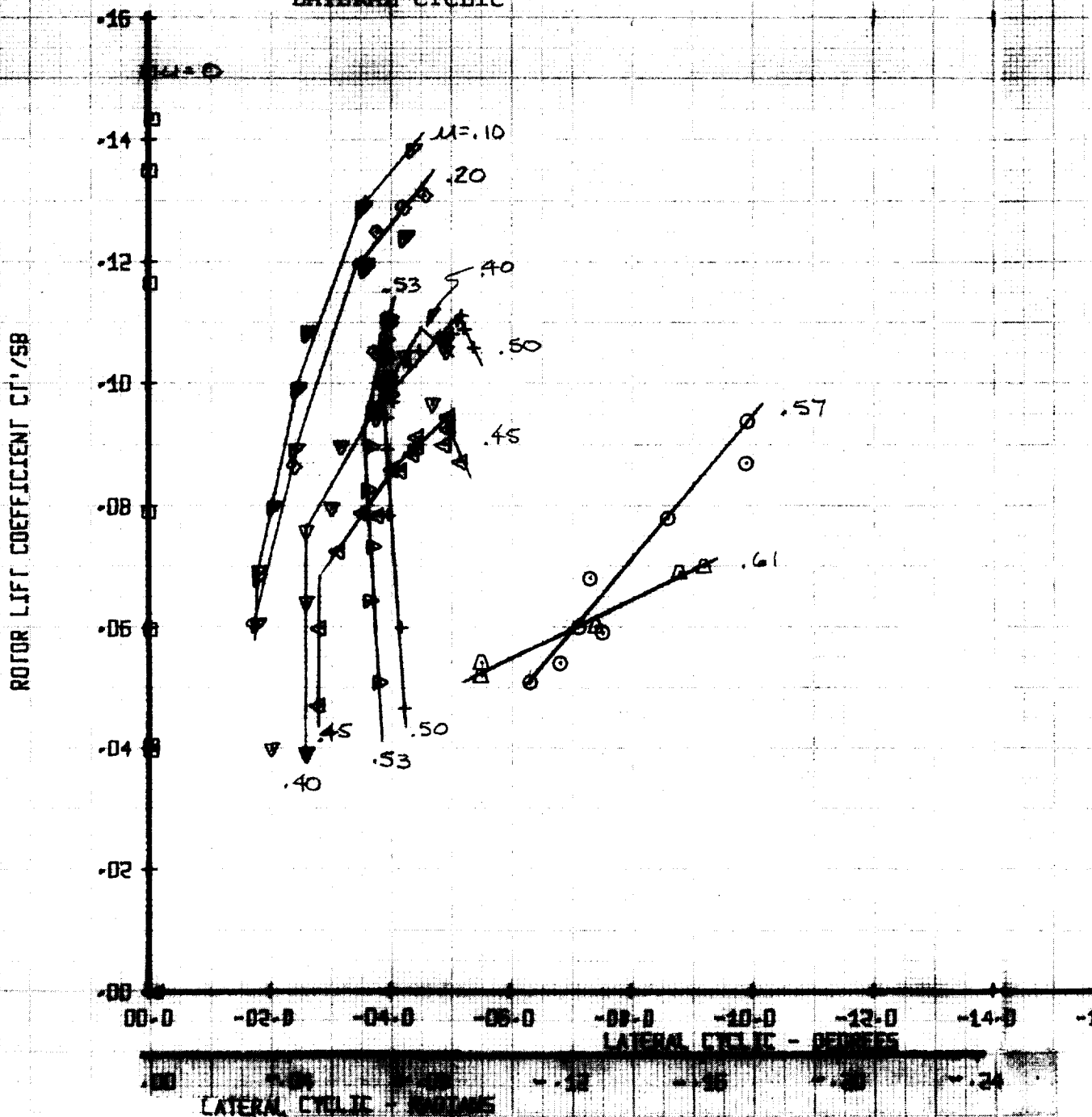
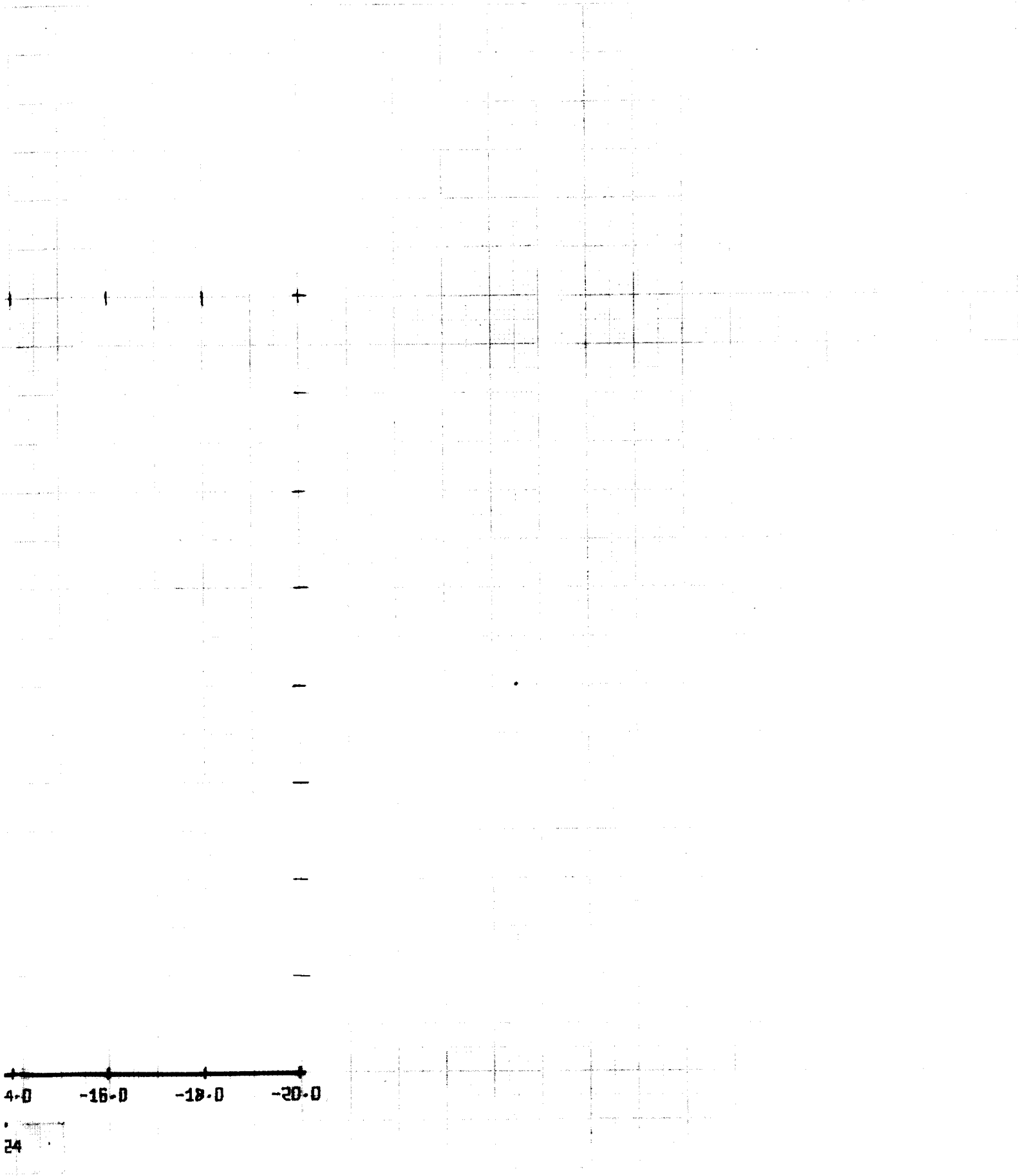


Figure D-4



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MU'	X/00258	VTUN
□	23	.0	.05	0
◇	25	.10	.05	62
△	27	.20	.05	124
▽	30	.40	.05	248
+	36	.45	.05	279
△	39	.50	.05	310
○	50	.53	.05	329
△	228	.57	.05	359
◇	229	.61	.05	378

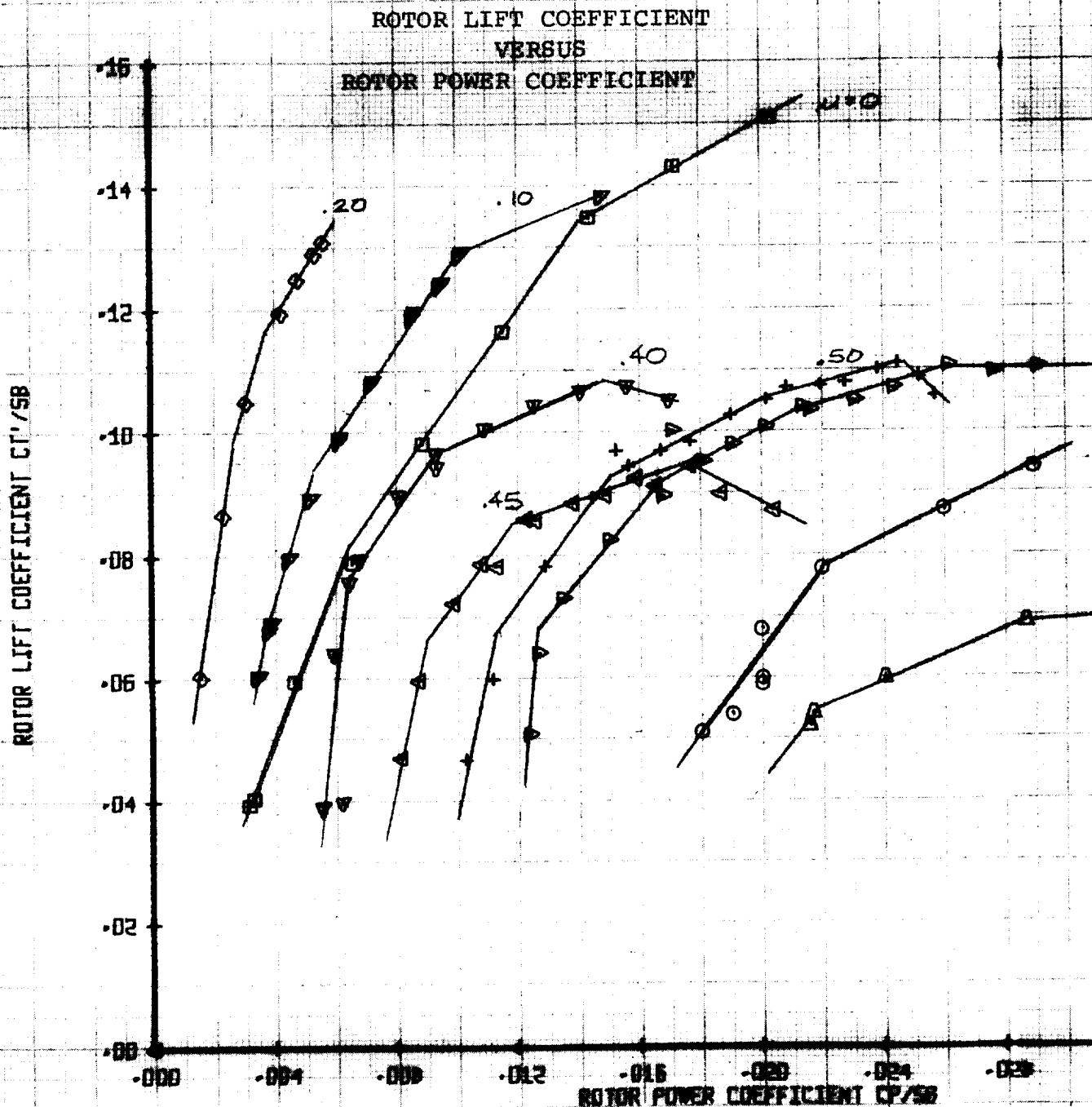


Figure D-5

→ .53

↗ .57

△△ .61

0 .032 .036 .040

EOLDOUT FRAME 2 D-7

SET 44
BVWT 193

+

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MU'	X/00258	VTUN
□	200	.10	.05	0
△	201	.10	.05	10
▽	202	.10	.05	20
+	203	.10	.05	30
△	204	.10	.05	40
○	205	.10	.05	50
△	206	.10	.05	60
○	207	.10	.05	70
△	208	.10	.05	80
○	209	.10	.05	90
△	210	.10	.05	100
○	211	.10	.05	110
△	212	.10	.05	120
○	213	.10	.05	130
△	214	.10	.05	140
○	215	.10	.05	150
△	216	.10	.05	160
○	217	.10	.05	170
△	218	.10	.05	180
○	219	.10	.05	190
△	220	.10	.05	200
○	221	.10	.05	210
△	222	.10	.05	220
○	223	.10	.05	230
△	224	.10	.05	240
○	225	.10	.05	250
△	226	.10	.05	260
○	227	.10	.05	270
△	228	.10	.05	280
○	229	.10	.05	290
△	230	.10	.05	300
○	231	.10	.05	310
△	232	.10	.05	320
○	233	.10	.05	330
△	234	.10	.05	340
○	235	.10	.05	350
△	236	.10	.05	360
○	237	.10	.05	370
△	238	.10	.05	380
○	239	.10	.05	390
△	240	.10	.05	400
○	241	.10	.05	410
△	242	.10	.05	420
○	243	.10	.05	430
△	244	.10	.05	440
○	245	.10	.05	450
△	246	.10	.05	460
○	247	.10	.05	470
△	248	.10	.05	480
○	249	.10	.05	490
△	250	.10	.05	500
○	251	.10	.05	510
△	252	.10	.05	520
○	253	.10	.05	530
△	254	.10	.05	540
○	255	.10	.05	550
△	256	.10	.05	560
○	257	.10	.05	570
△	258	.10	.05	580
○	259	.10	.05	590
△	260	.10	.05	600
○	261	.10	.05	610
△	262	.10	.05	620
○	263	.10	.05	630
△	264	.10	.05	640
○	265	.10	.05	650
△	266	.10	.05	660
○	267	.10	.05	670
△	268	.10	.05	680
○	269	.10	.05	690
△	270	.10	.05	700
○	271	.10	.05	710
△	272	.10	.05	720
○	273	.10	.05	730
△	274	.10	.05	740
○	275	.10	.05	750
△	276	.10	.05	760
○	277	.10	.05	770
△	278	.10	.05	780
○	279	.10	.05	790
△	280	.10	.05	800
○	281	.10	.05	810
△	282	.10	.05	820
○	283	.10	.05	830
△	284	.10	.05	840
○	285	.10	.05	850
△	286	.10	.05	860
○	287	.10	.05	870
△	288	.10	.05	880
○	289	.10	.05	890
△	290	.10	.05	900
○	291	.10	.05	910
△	292	.10	.05	920
○	293	.10	.05	930
△	294	.10	.05	940
○	295	.10	.05	950
△	296	.10	.05	960
○	297	.10	.05	970
△	298	.10	.05	980
○	299	.10	.05	990
△	300	.10	.05	1000

ROTOR LIFT COEFFICIENT
VERSUS
ALTERNATING ROOT TORSION TB12

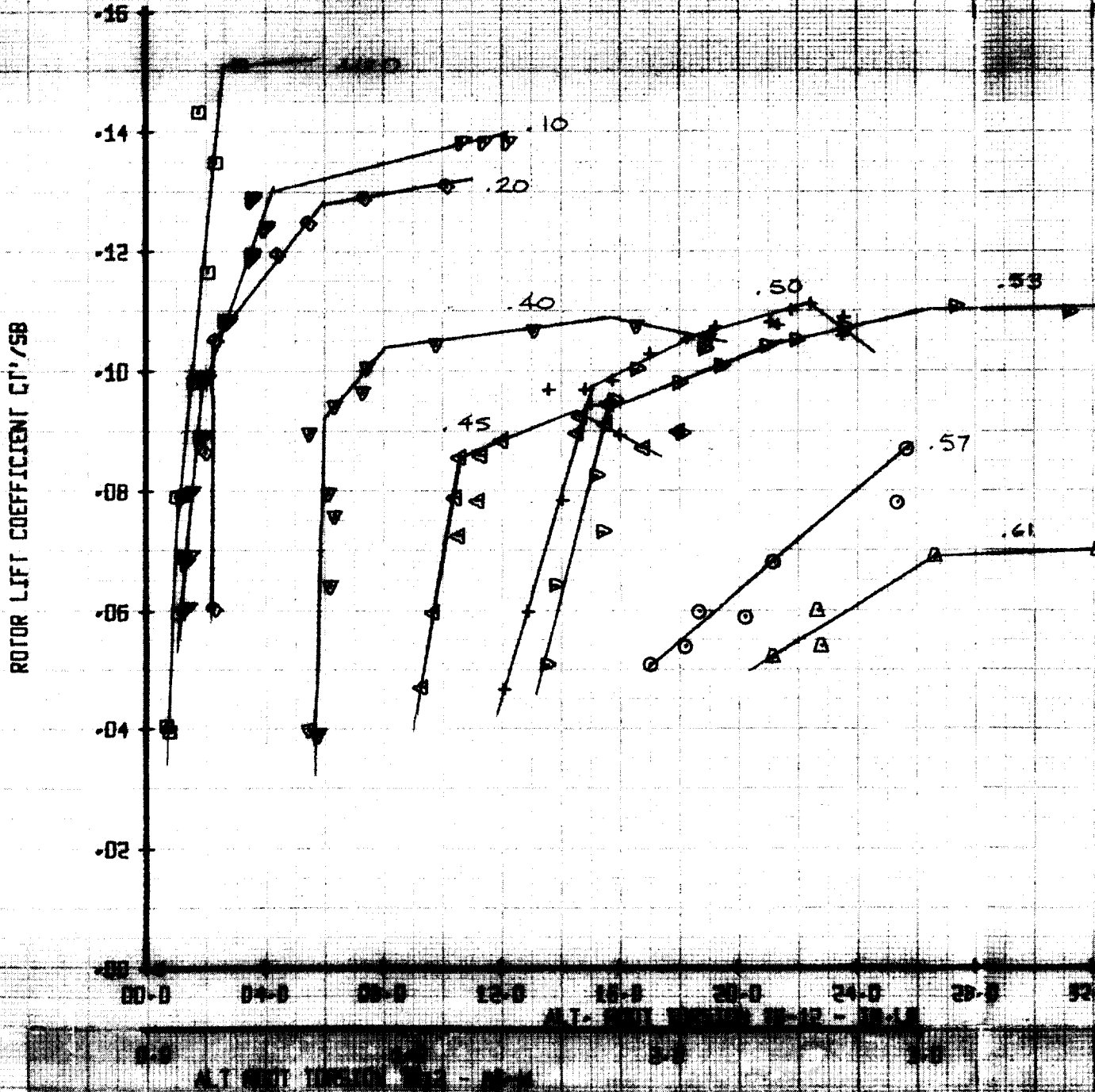
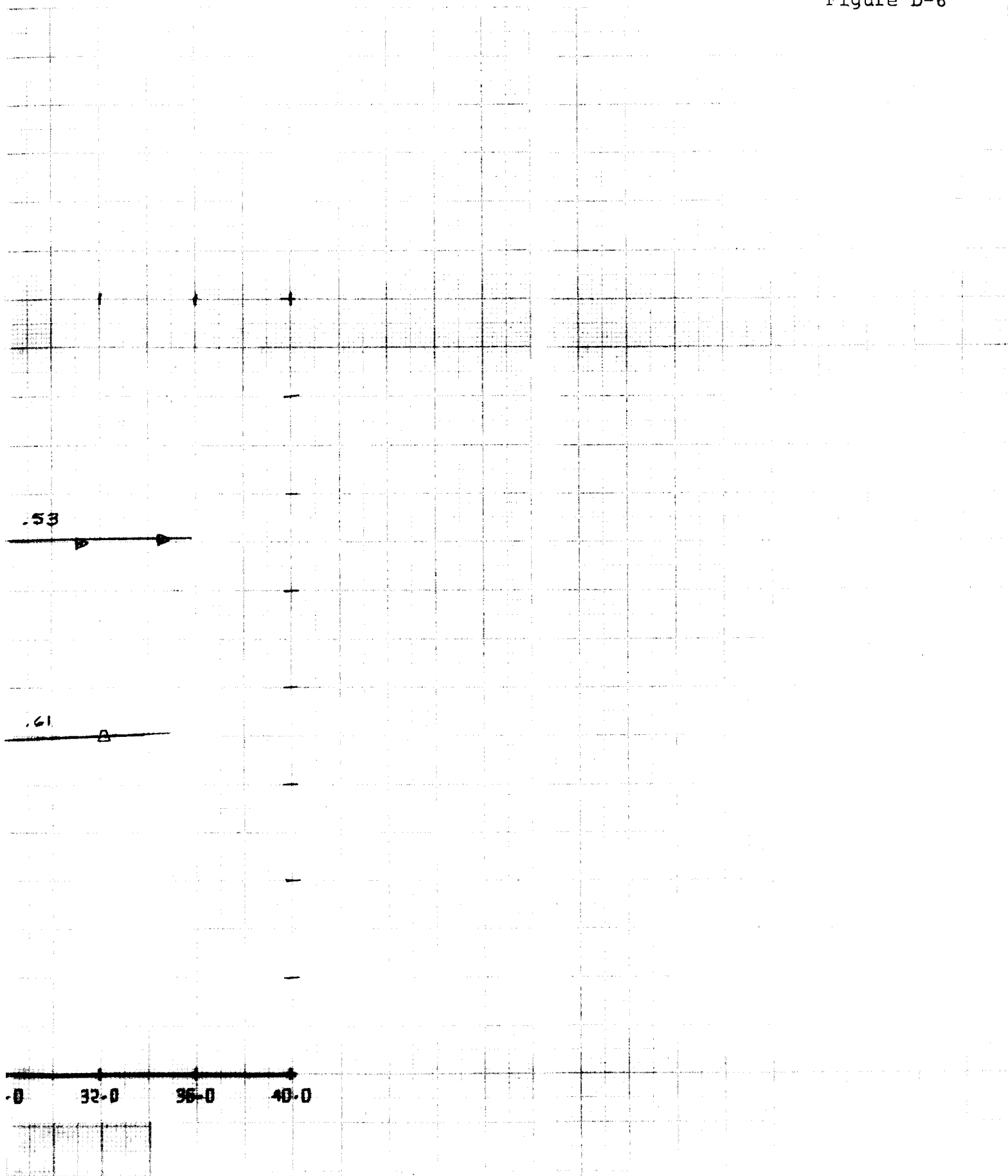


Figure D-6



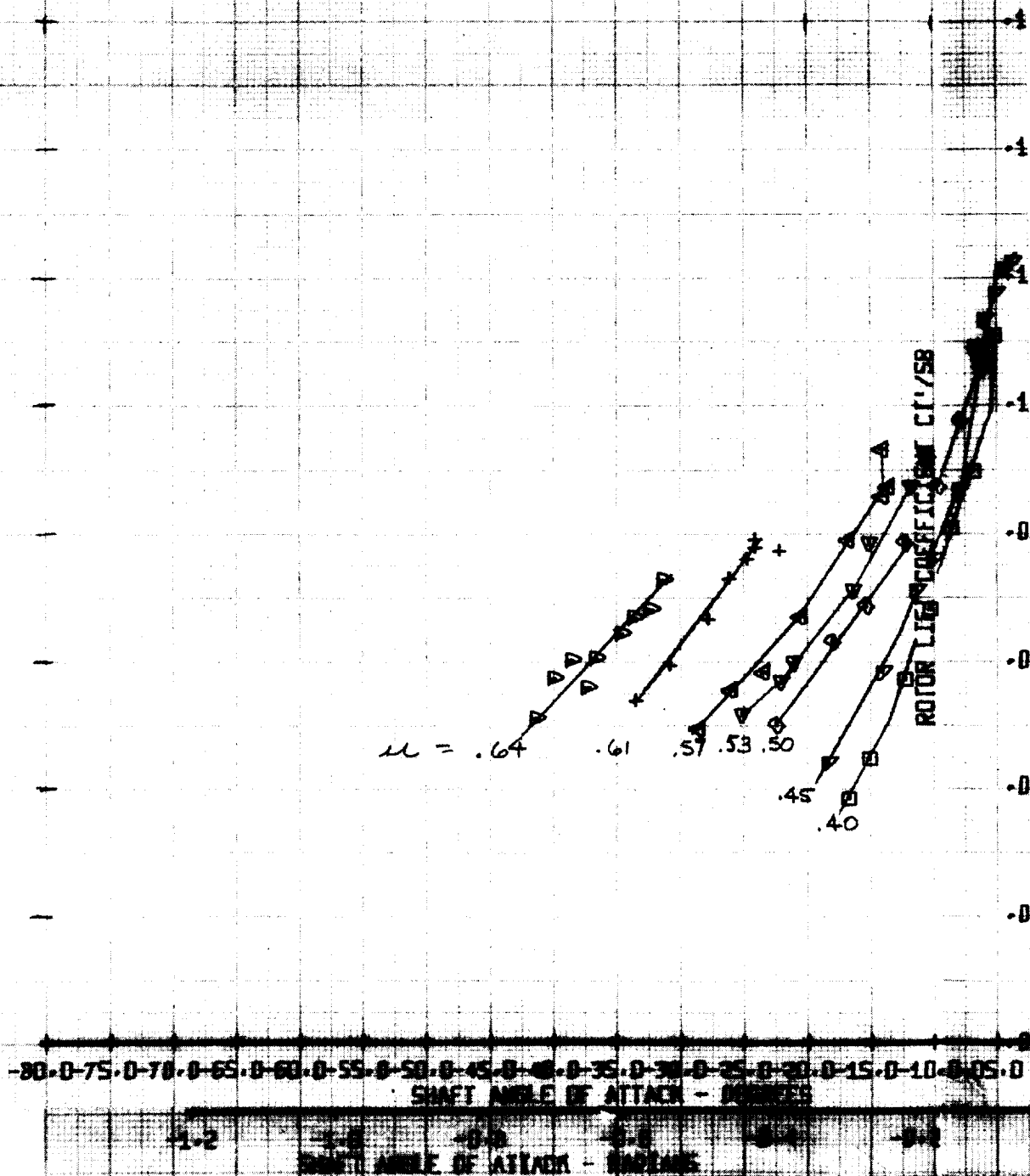
OLDOUT FRAME 2 D-8

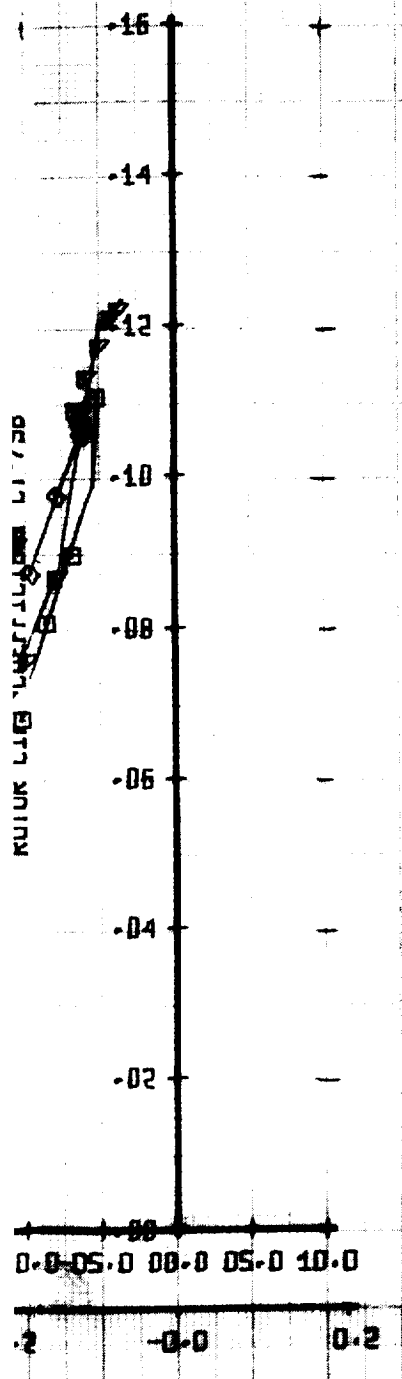
SET 44
BVWT 193

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MU'	X/OD2SB	Y/TUN
□	256	.40	.05	230
△	255	.45	.05	240
◇	254	.50	.05	250
▽	257	.53	.05	260
+	258	.57	.05	325
	259	.61	.05	340
	260	.64	.05	360

ROTOR LIFT COEFFICIENT
VERSUS
SHAFT ANGLE OF ATTACK





LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	ML'	X/00258	VTUN
□	256	.40	.05	228
△	255	.45	.05	256
◇	254	.50	.05	285
▽	257	.53	.05	302
+△	258	.57	.05	325
▽+	259	.61	.05	348
△	260	.64	.05	368

ROTOR LIFT COEFFICIENT
VERSUS
COLLECTIVE PITCH

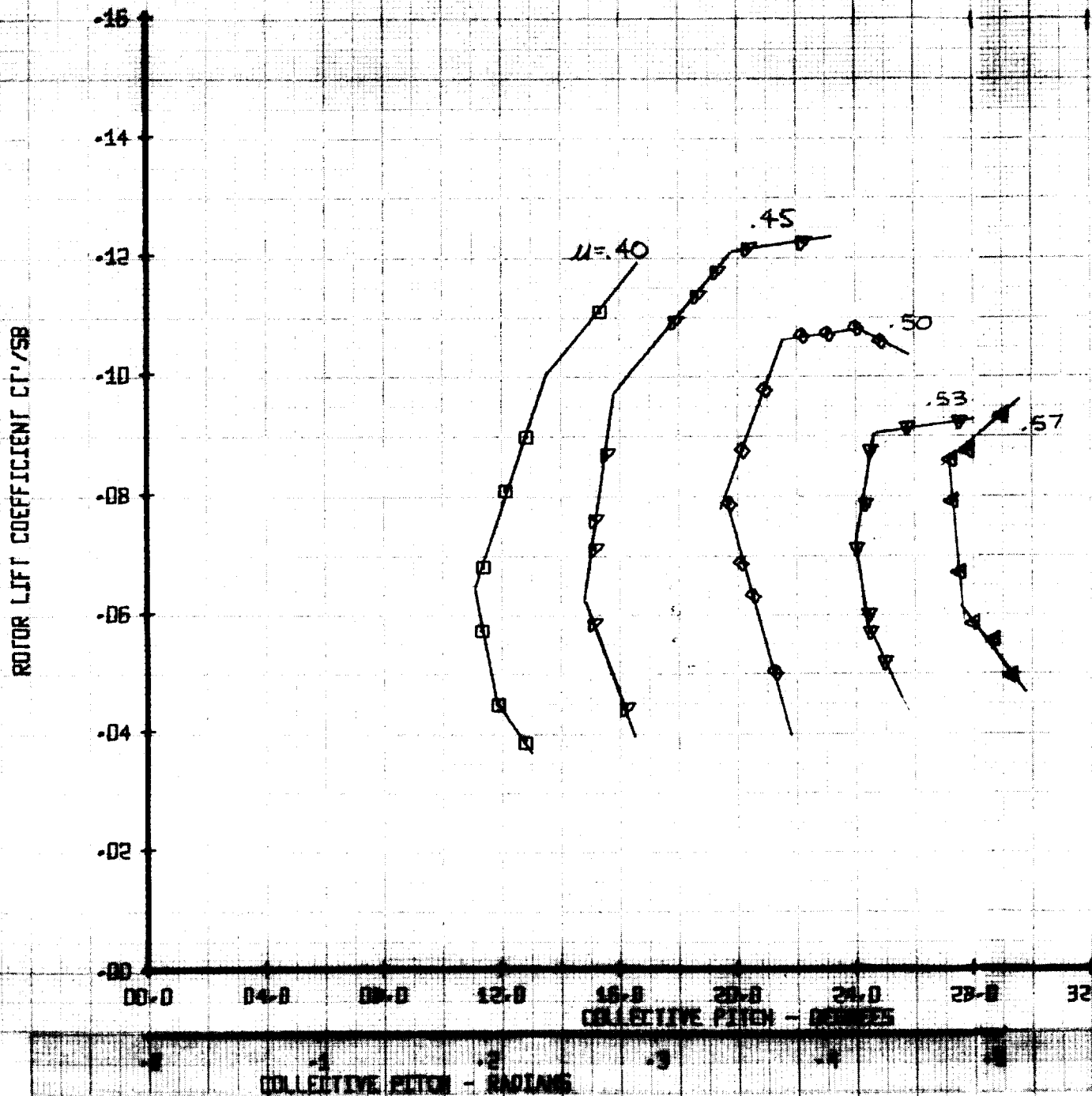
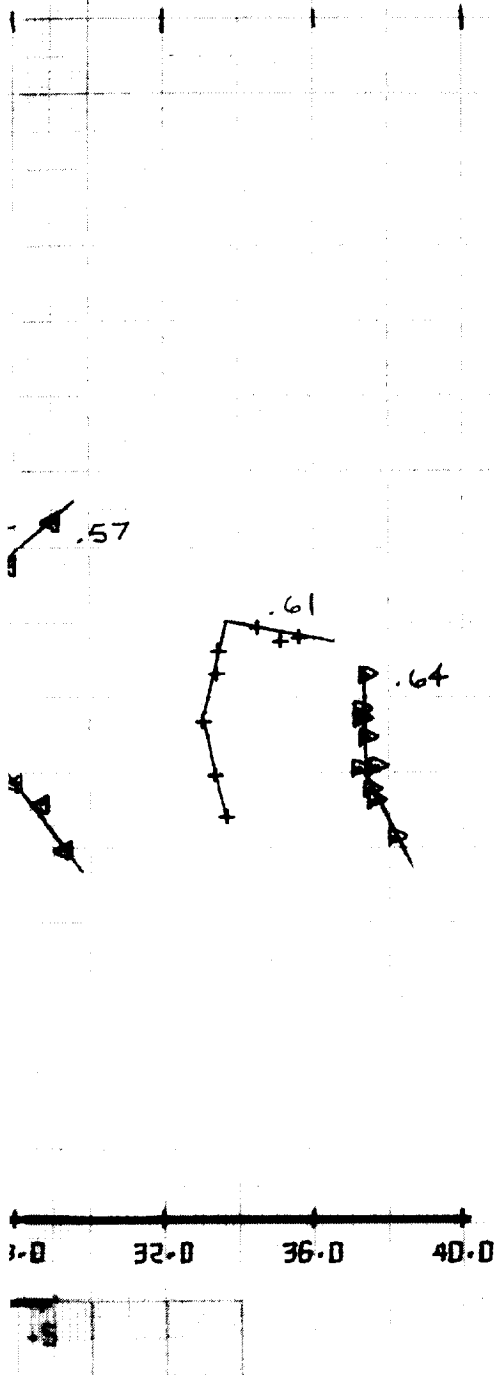


Figure D-8



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH7B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MLI'	X/DD258	Y/LIN
□	256	.40	.05	258
◊	255	.45	.05	256
◊	254	.50	.05	255
◊	257	.53	.05	300
◊	258	.57	.05	320
△	259	.61	.05	340
△	260	.64	.05	360

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

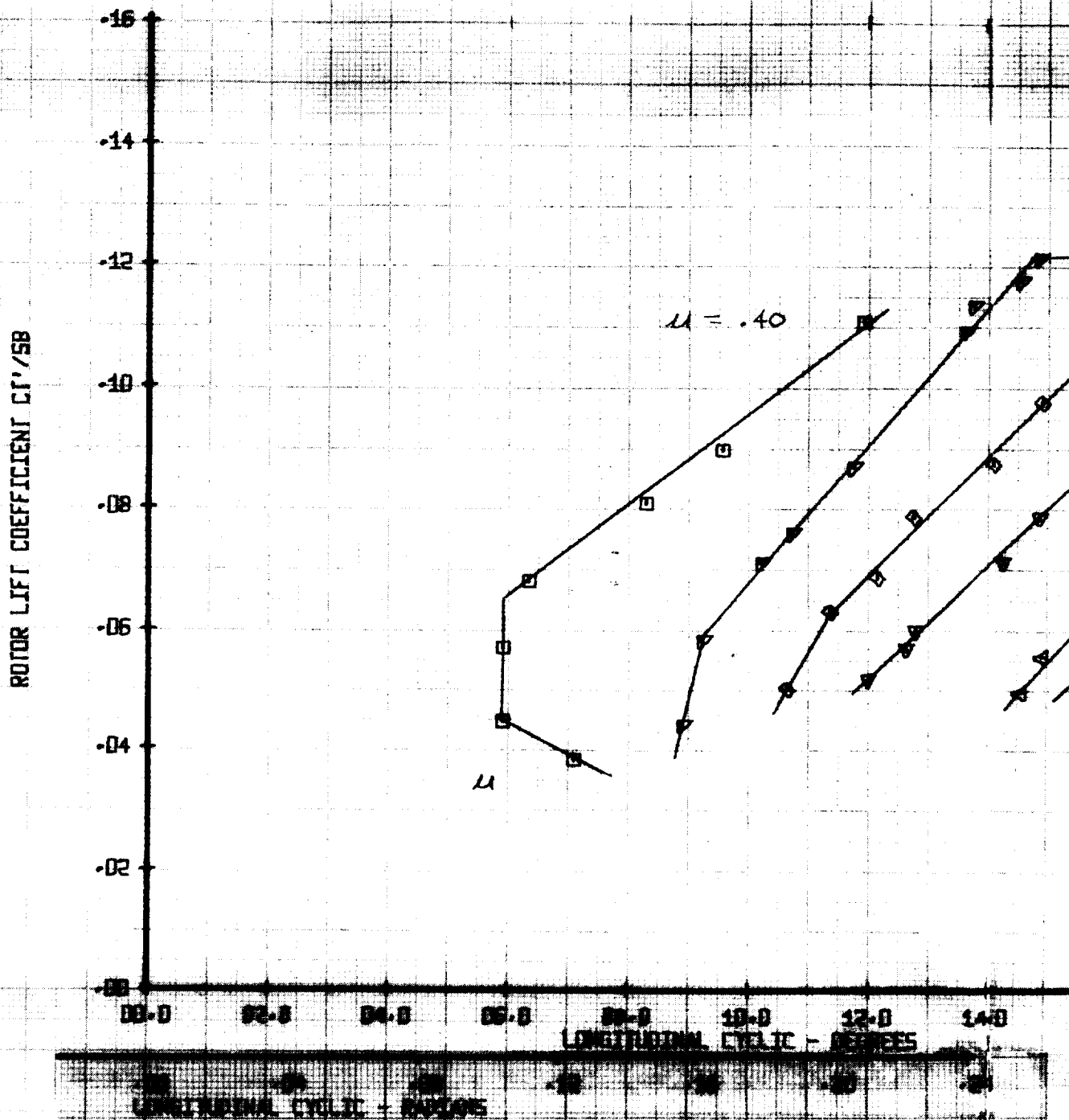
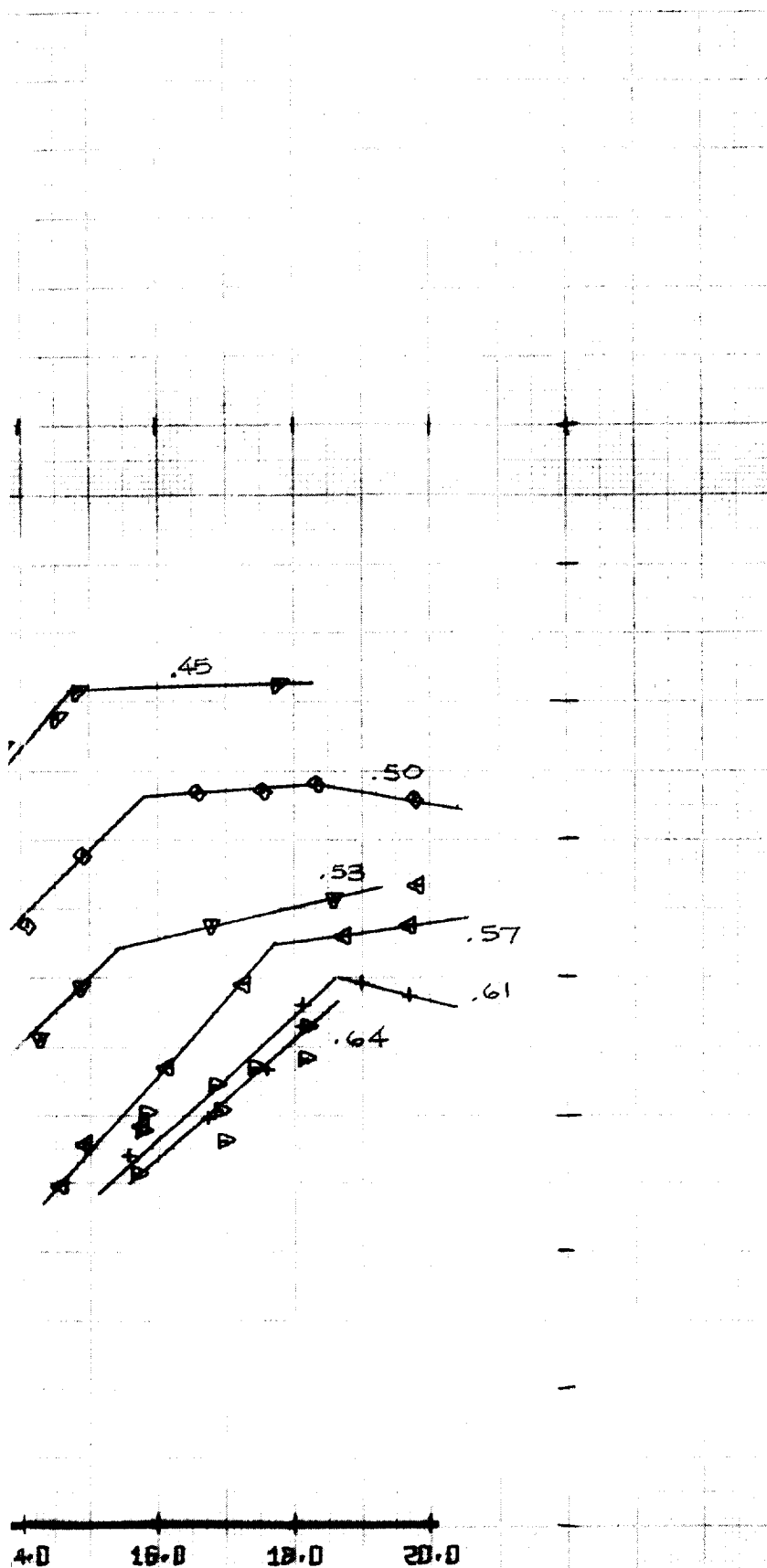


Figure D-9



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MLI'	X/00258	Y/TIN
□	256	.40	.05	228
△	255	.45	.05	236
◇	254	.50	.05	246
▽	257	.53	.05	302
+	258	.57	.05	325
×	259	.61	.05	349
•	260	.64	.05	368

ROTOR LIFT COEFFICIENT
VERSUS
LATERAL CYCLIC

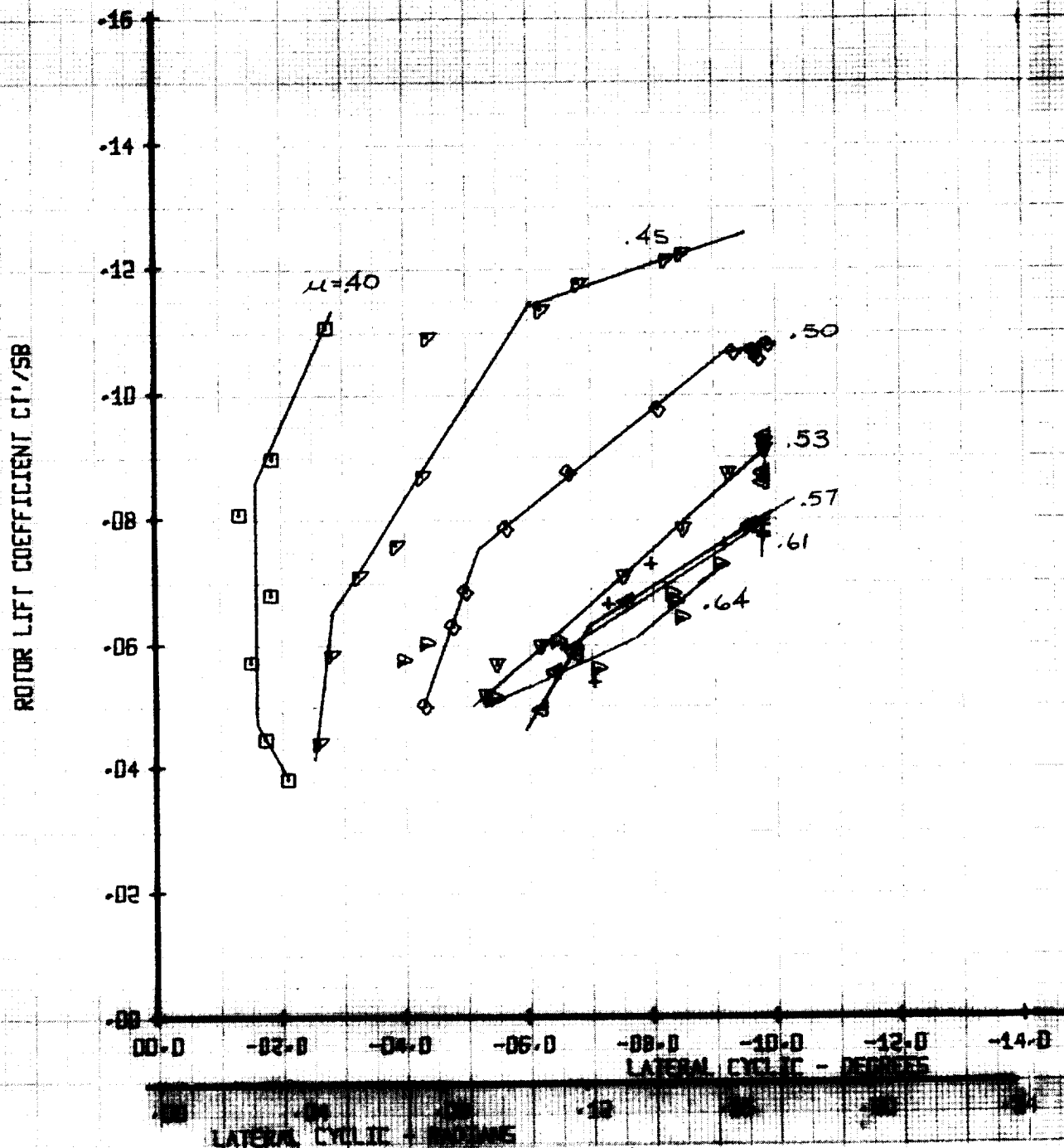
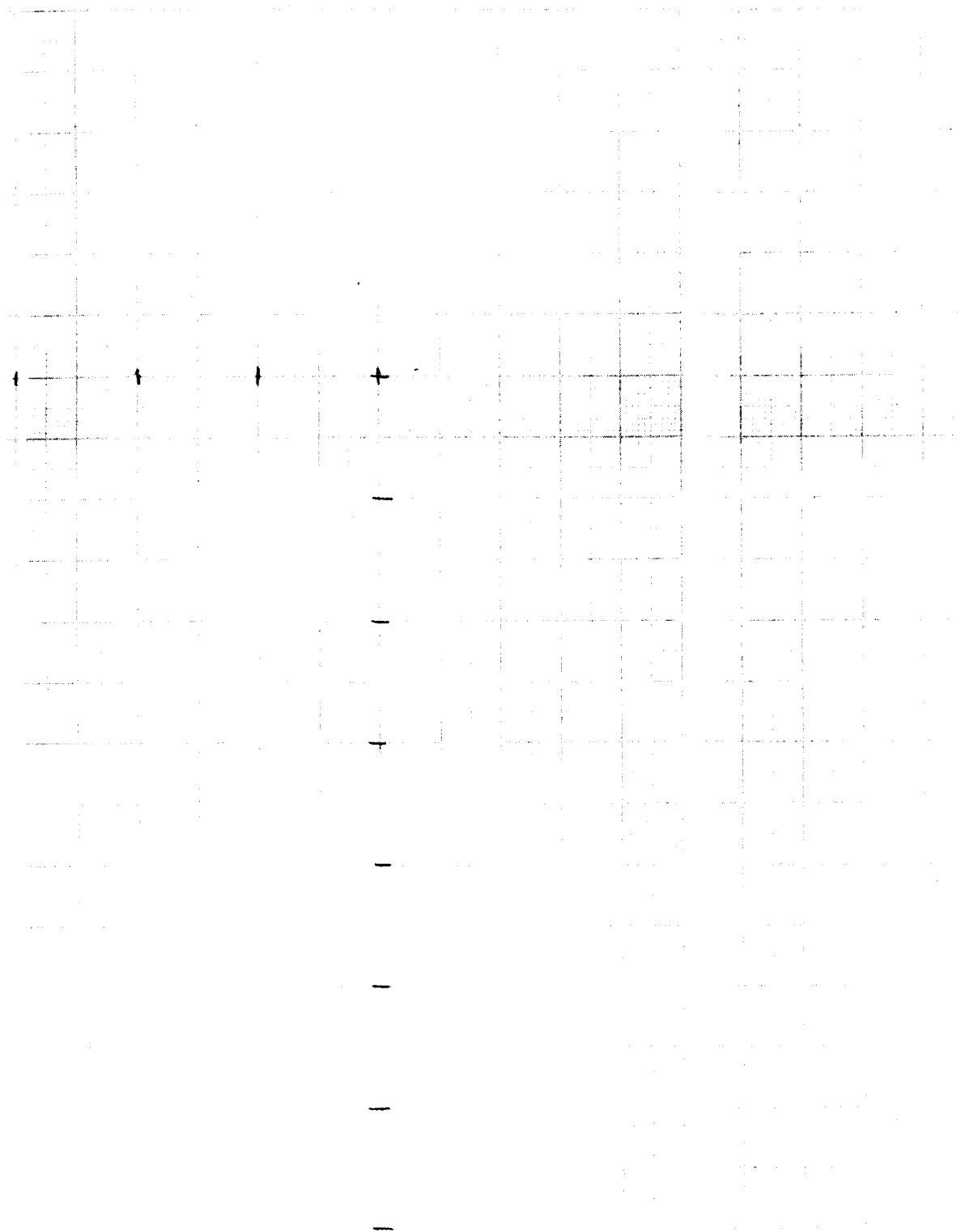
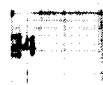


Figure D-10



4.0 -16.0 -18.0 -20.0



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MLI'	X/CD258	VTUN
□	2396	.40	.05	238
△	2397	.45	.05	256
◇	2401	.50	.05	285
▽	2402	.53	.05	302
+	2403	.57	.05	325
	2405	.61	.05	348
	2406	.64	.05	368

ROTOR LIFT COEFFICIENT
VERSUS
ROTOR POWER COEFFICIENT

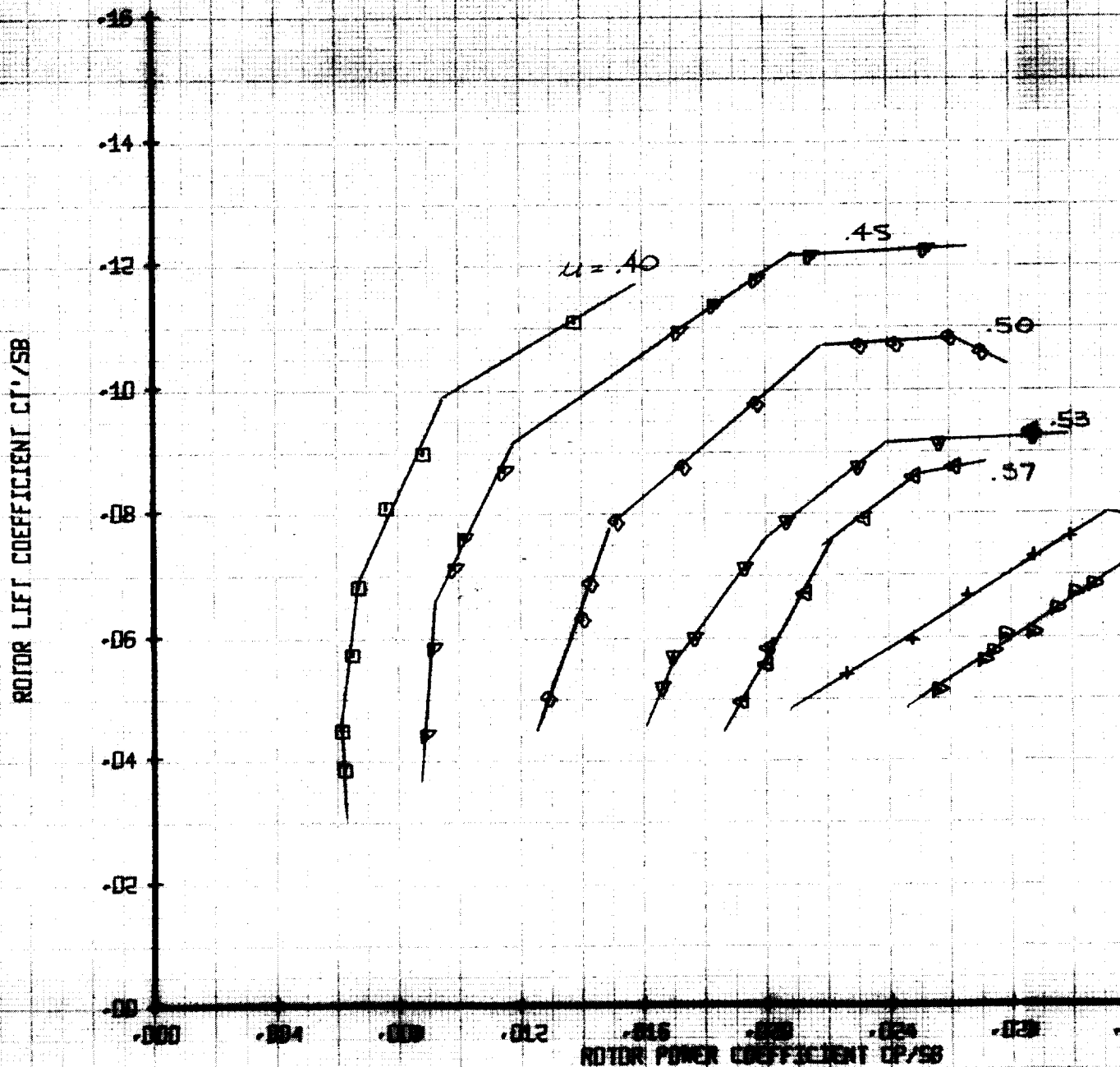
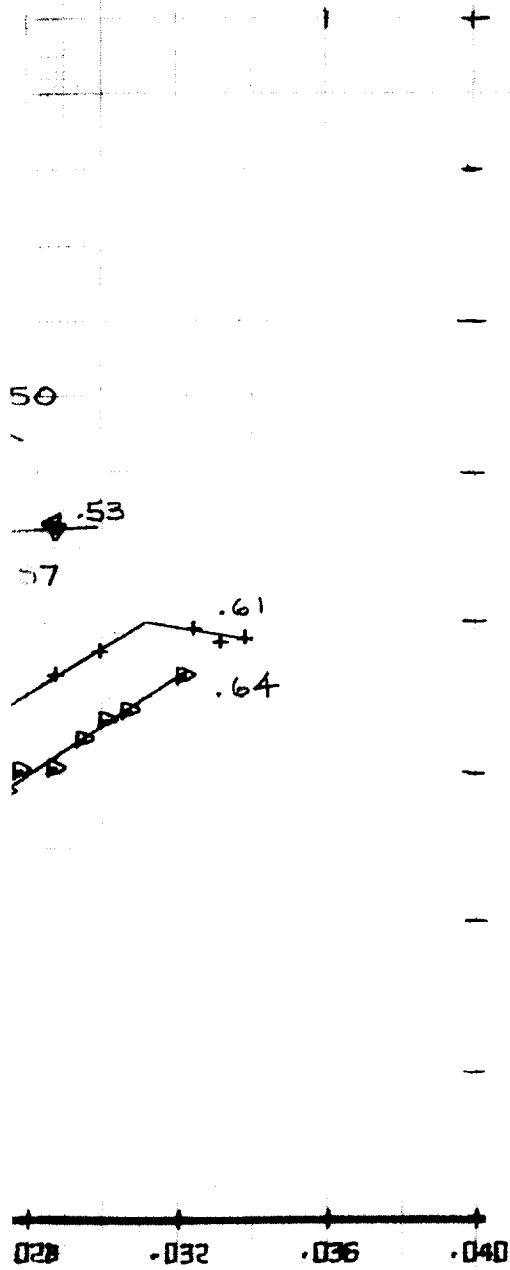


Figure D-11



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MU'	X/00258	Y/TUN
□	256	.40	.05	238
◻	255	.45	.05	236
◊	254	.50	.05	235
△	257	.53	.05	302
+△	258	.57	.05	325
+	259	.61	.05	340
△	260	.64	.05	360

ROTOR LIFT COEFFICIENT
VERSUS
ALTERNATING ROOT TORSION TB12

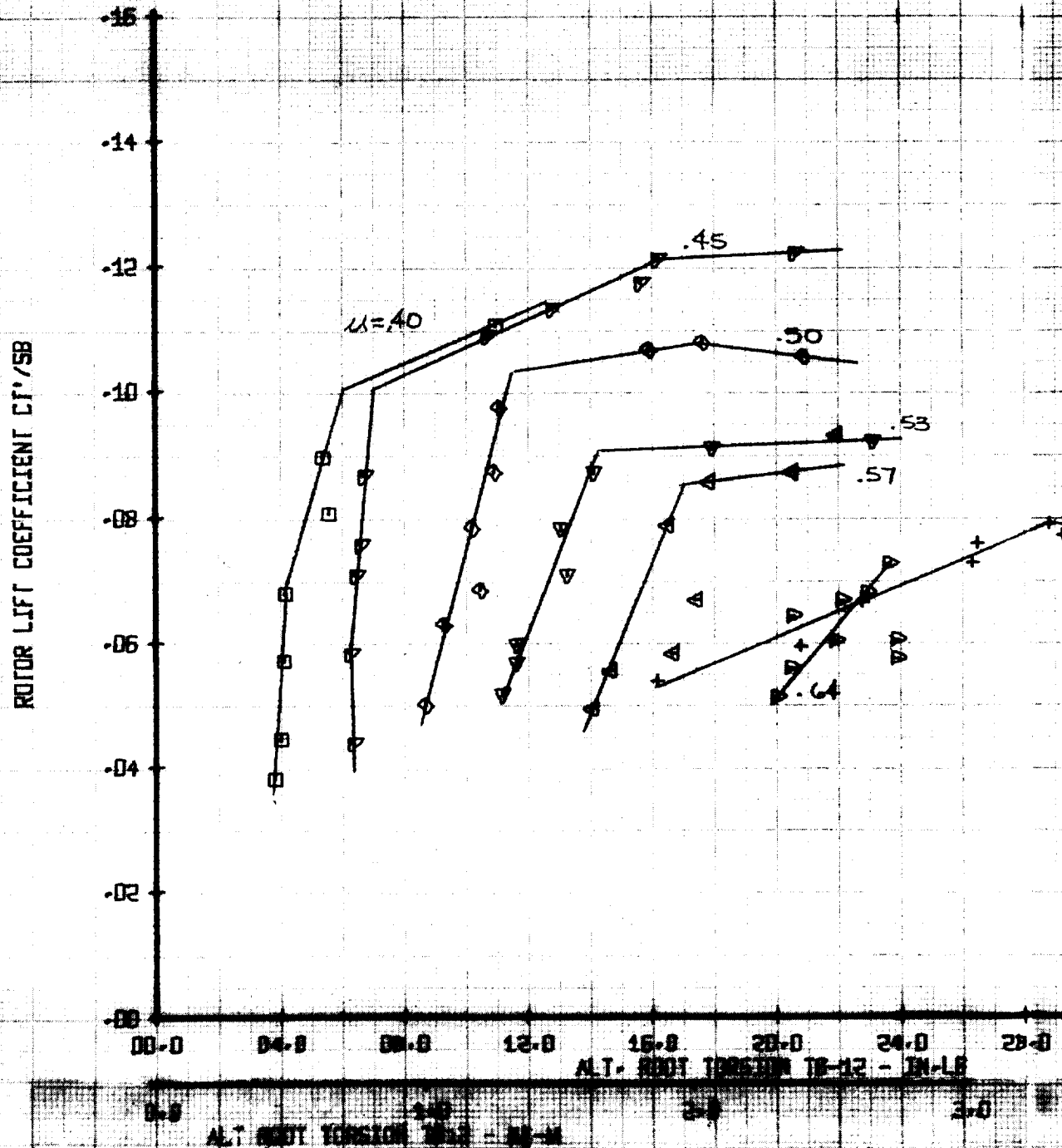
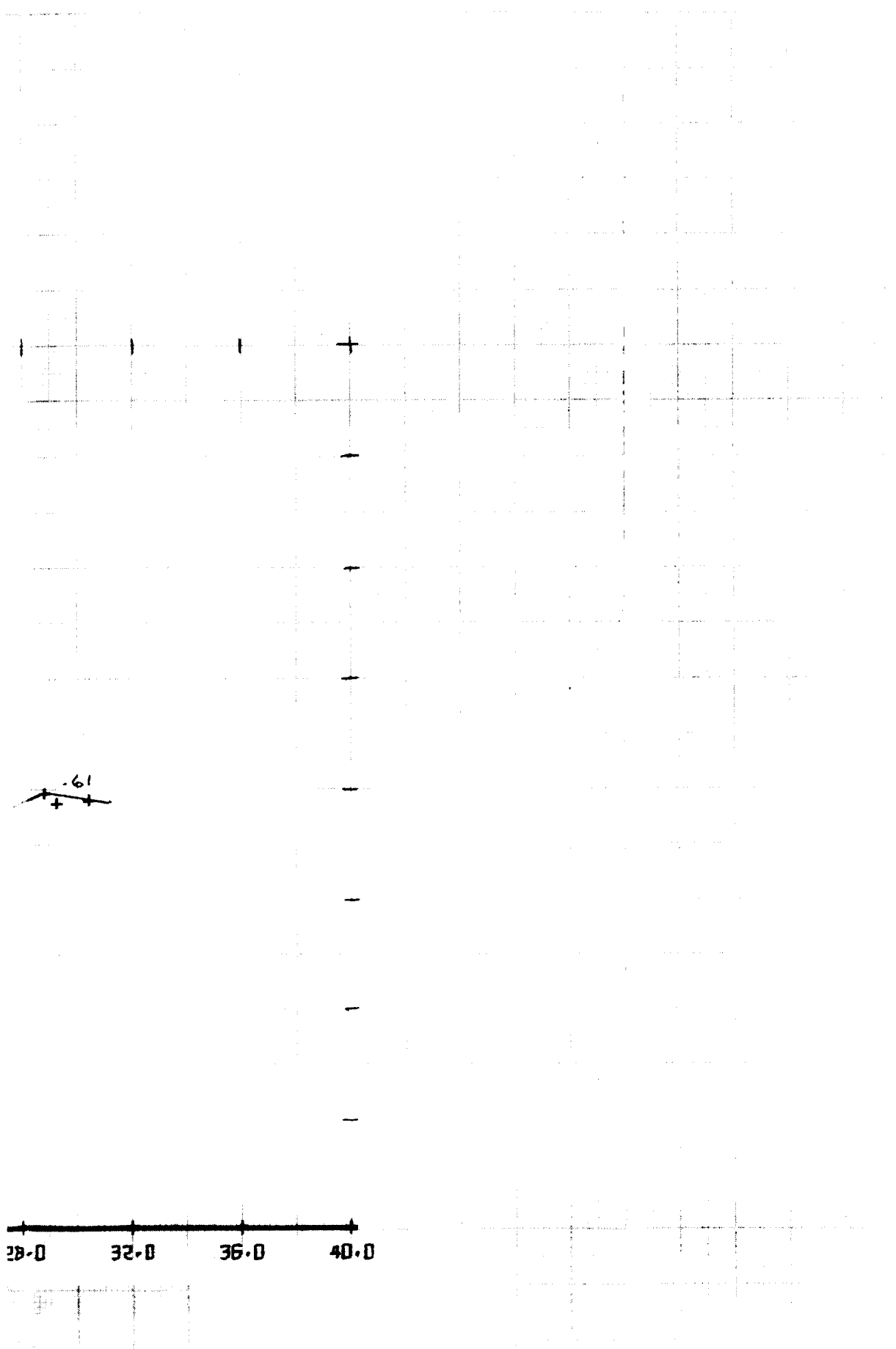


Figure D-12



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

LEGEND				
SYM	RLIN	MLI'	X/00258	YTLIN
□	227	.45	.05	279
◇	225	.50	.05	310
◆	224	.53	.05	308
▼	273	RANGE	.05	RANGE
△	274	RANGE	.05	RANGE
○	25	.10	.05	62
○	28	.20	.05	124
△	29	.30	.05	186

ROTOR LIFT COEFFICIENT
VERSUS
SHAFT ANGLE OF ATTACK

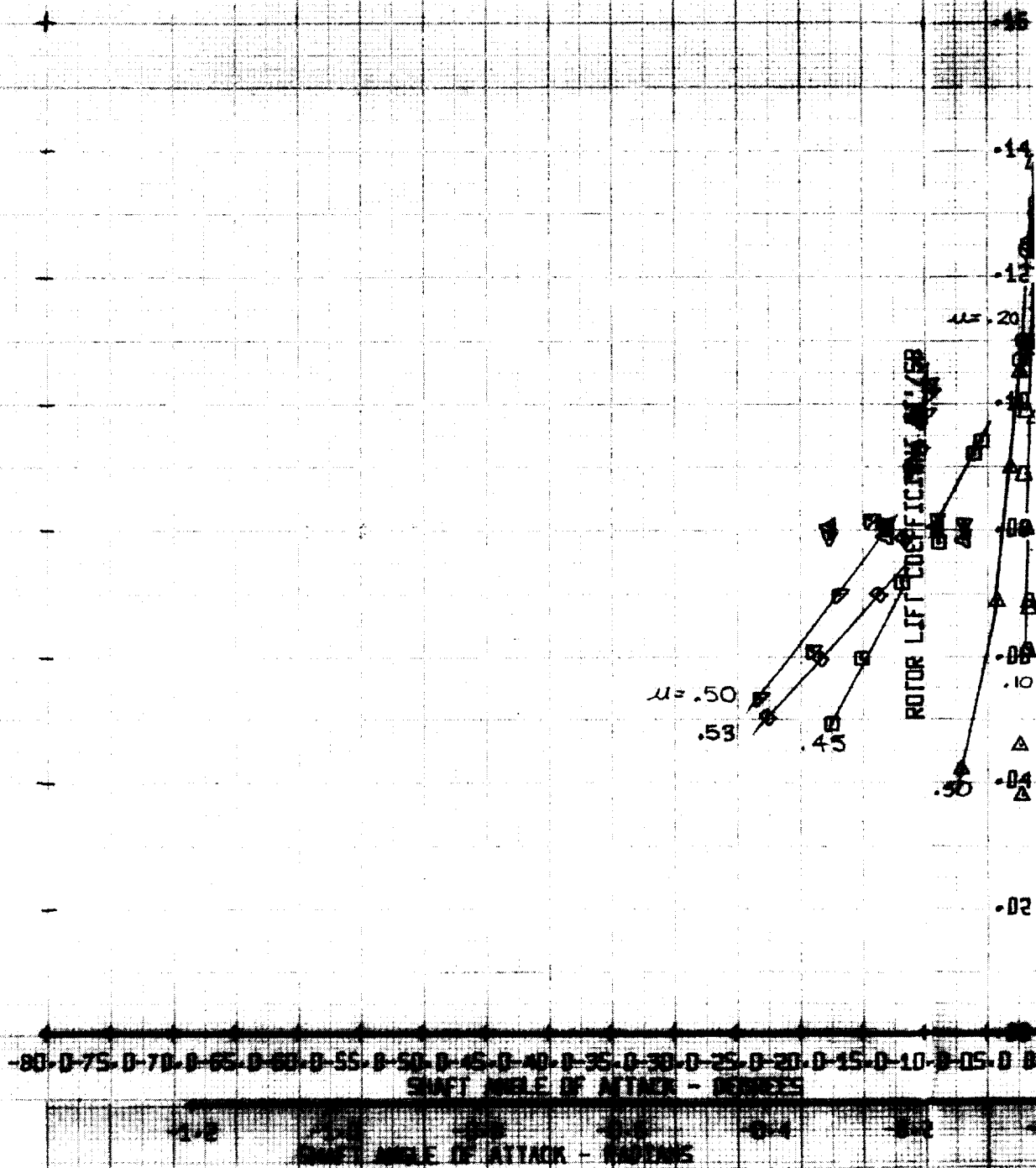
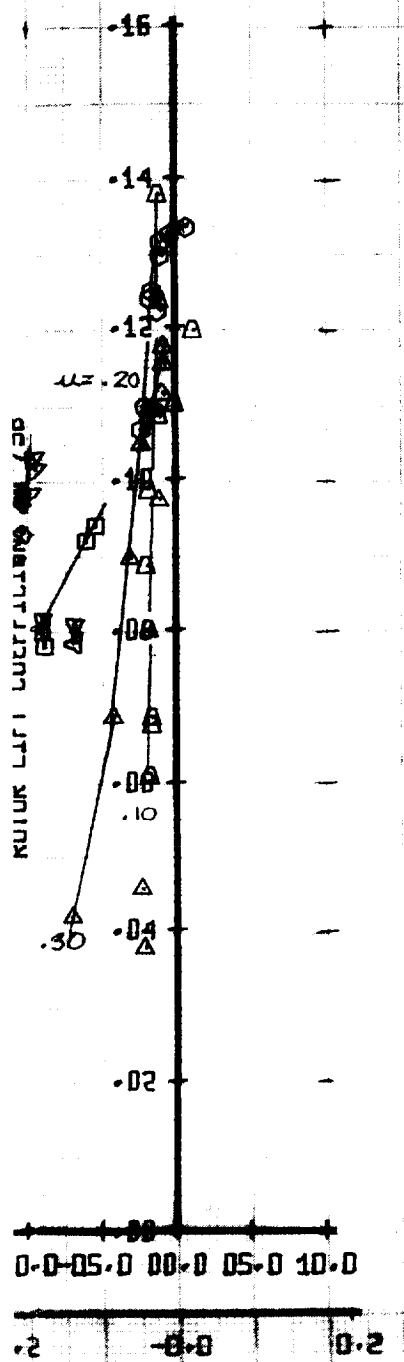


Figure D-13



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	BLIN	MU'	X/DB2SB	Y/TIN
□	227	.45	.05	279
▽	225	.50	.05	310
◇	224	.53	.05	300
▼	273	RANGE	.05	RANGE
△	274	RANGE	.05	RANGE
○	23	0	.06	0
△	25	.10	.05	62
○	26	.20	.05	124
△	29	.30	.05	186

ROTOR LIFT COEFFICIENT
VERSUS
COLLECTIVE PITCH

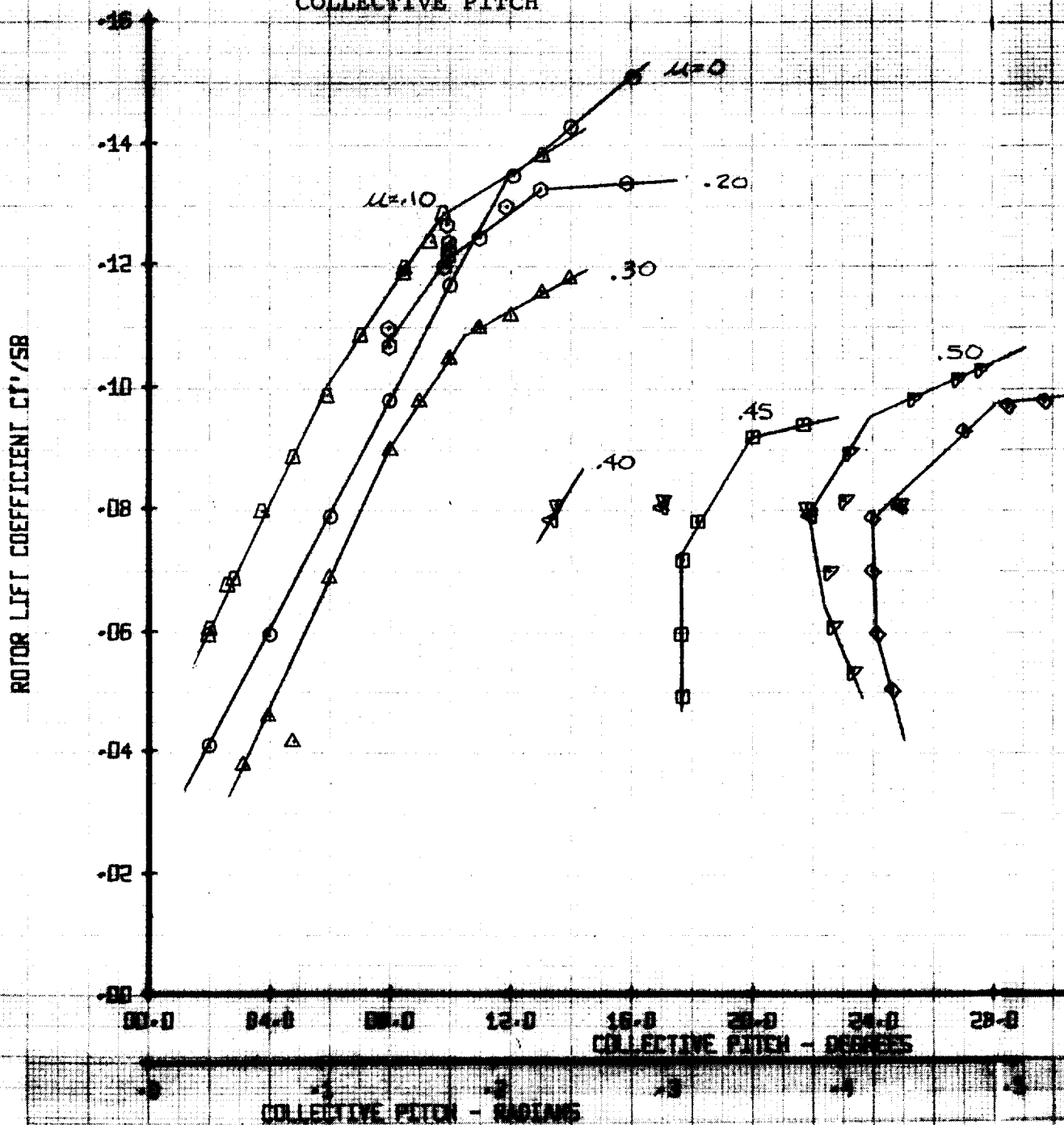
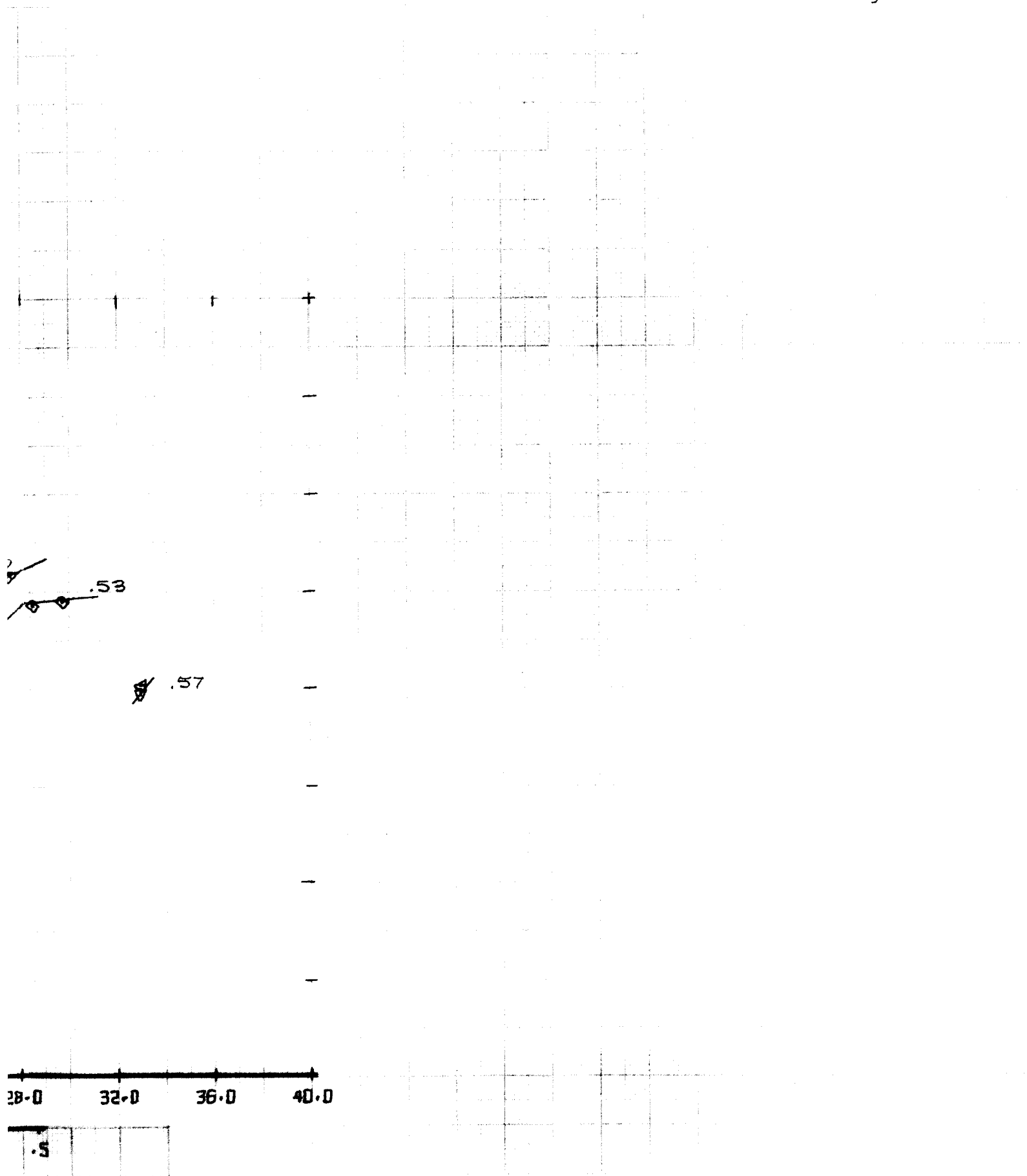


Figure D-14



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MI'	X/00258	Y/TUN
□	227	.45	.05	279
△	225	.50	.05	310
▽	224	.52	.05	328
▽	273	RANGE	.05	RANGE
△	274	RANGE	.05	RANGE
△	25	.10	.05	62
○	28	.20	.05	124
△	29	.30	.05	166

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

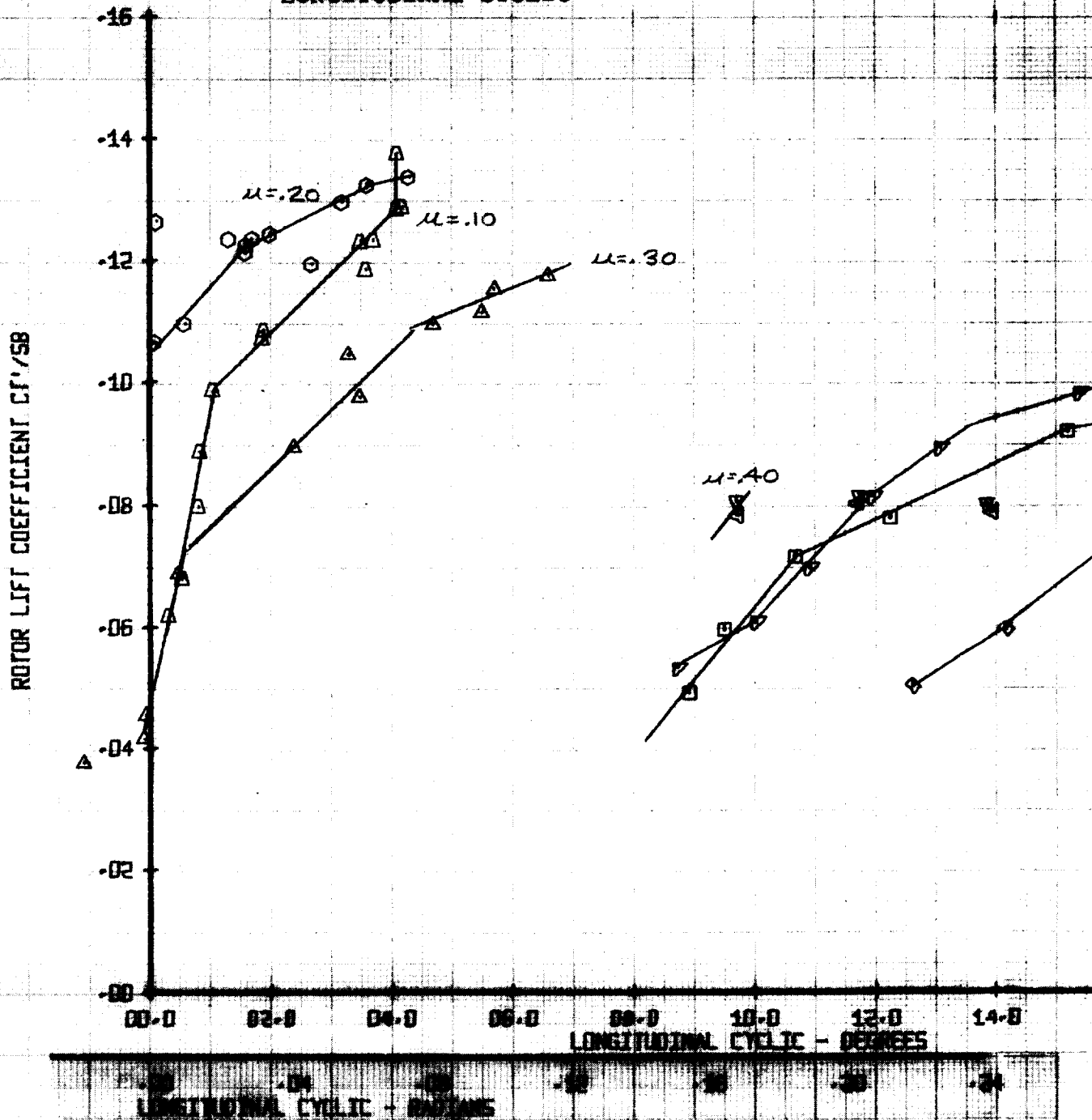
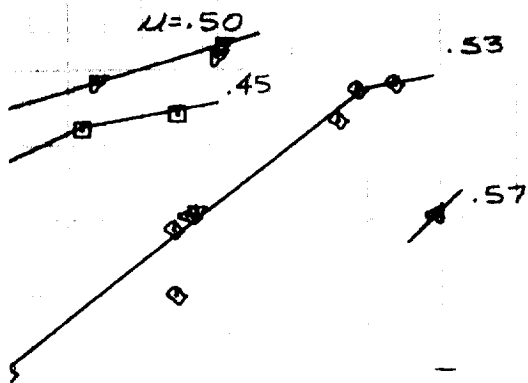


Figure D-15



0 16.0 18.0 20.0

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH47B ROTOR
 PERFORMANCE SUMMARY

SYM	RUN	MLI'	X/00258	Y/TUN
□	227	.45	.05	279
◇	225	.50	.05	310
▽	224	.53	.05	328
△	273	RANGE	.05	RANGE
△	274	RANGE	.05	RANGE
△	25	.10	.05	62
○	28	.20	.05	124
△	29	.30	.05	186

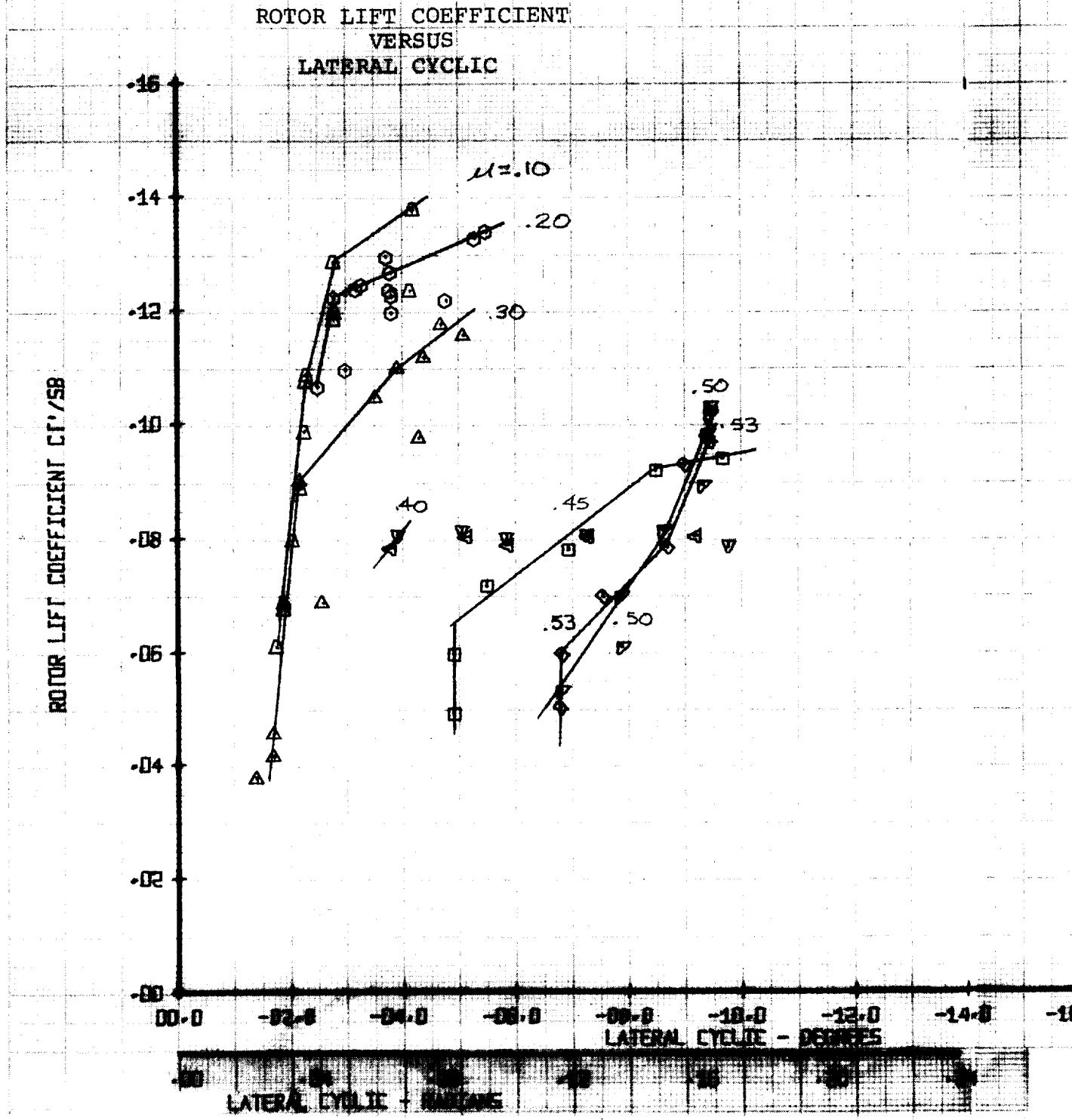
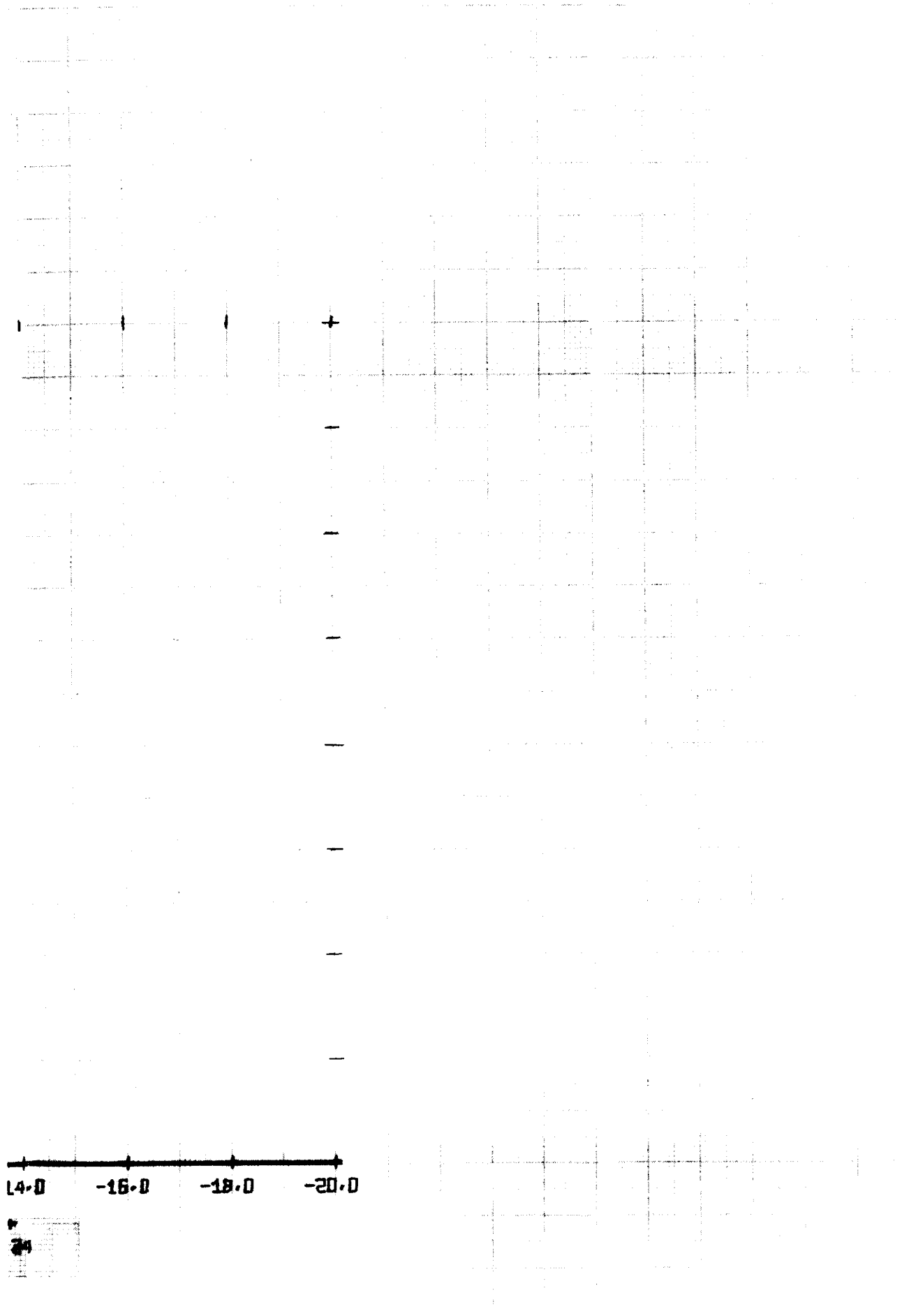


Figure D-16



D-18

FOLDOUT, FRAME 2

SET 43
BWV 193

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MLI'	X/00258	VTUN
□	227	.45	.05	279
◇	228	.50	.05	310
△	224	.53	.05	328
▽	273	RANGE	.05	RANGE
△	274	RANGE	.05	RANGE
○	23	0	.05	0
△	25	.10	.05	62
○	28	.20	.05	124
△	29	.30	.05	186

ROTOR LIFT COEFFICIENT
VERSUS
ROTOR POWER COEFFICIENT

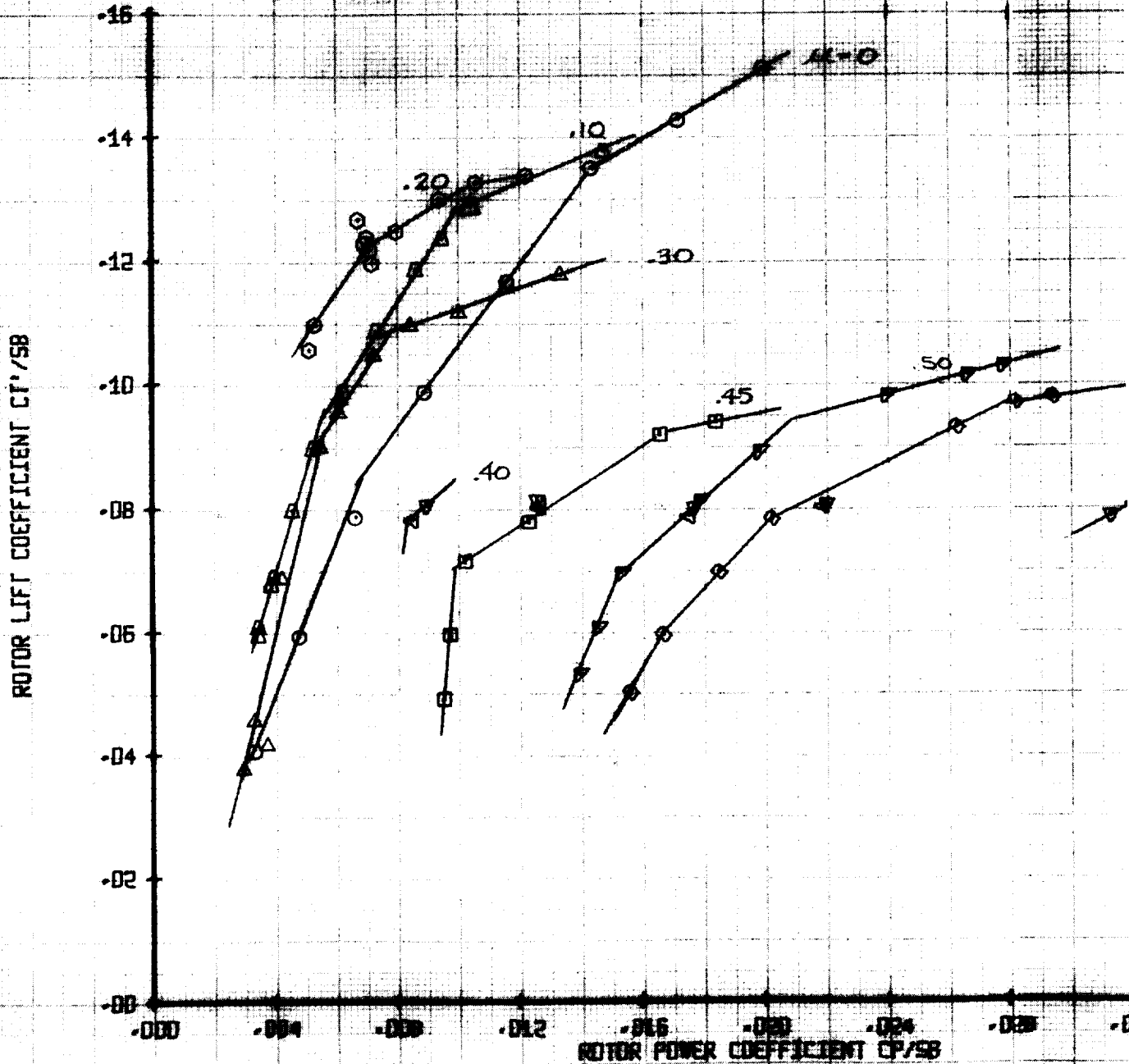
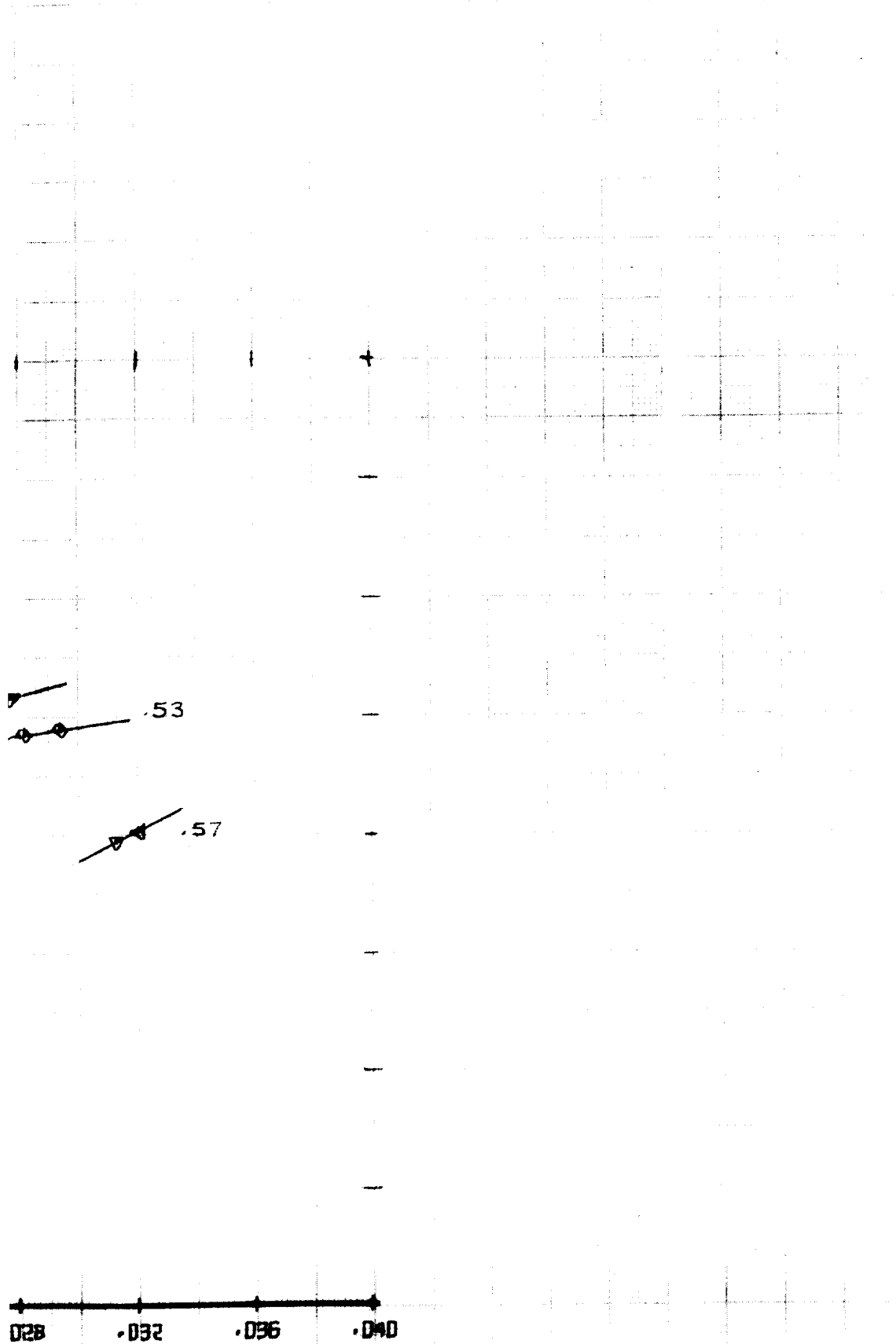


Figure D-17



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

LEGEND				
SYM	RUN	MU'	X/DO258	Y/TUN
□	227	.45	.05	279
▣	225	.50	.05	310
◊	234	.53	.05	328
▽	273	RANGE	.05	RANGE
△	274	RANGE	.05	RANGE
○	23	0	.05	0
◊	25	.10	.05	62
○	28	.20	.05	124
△	29	.30	.05	186

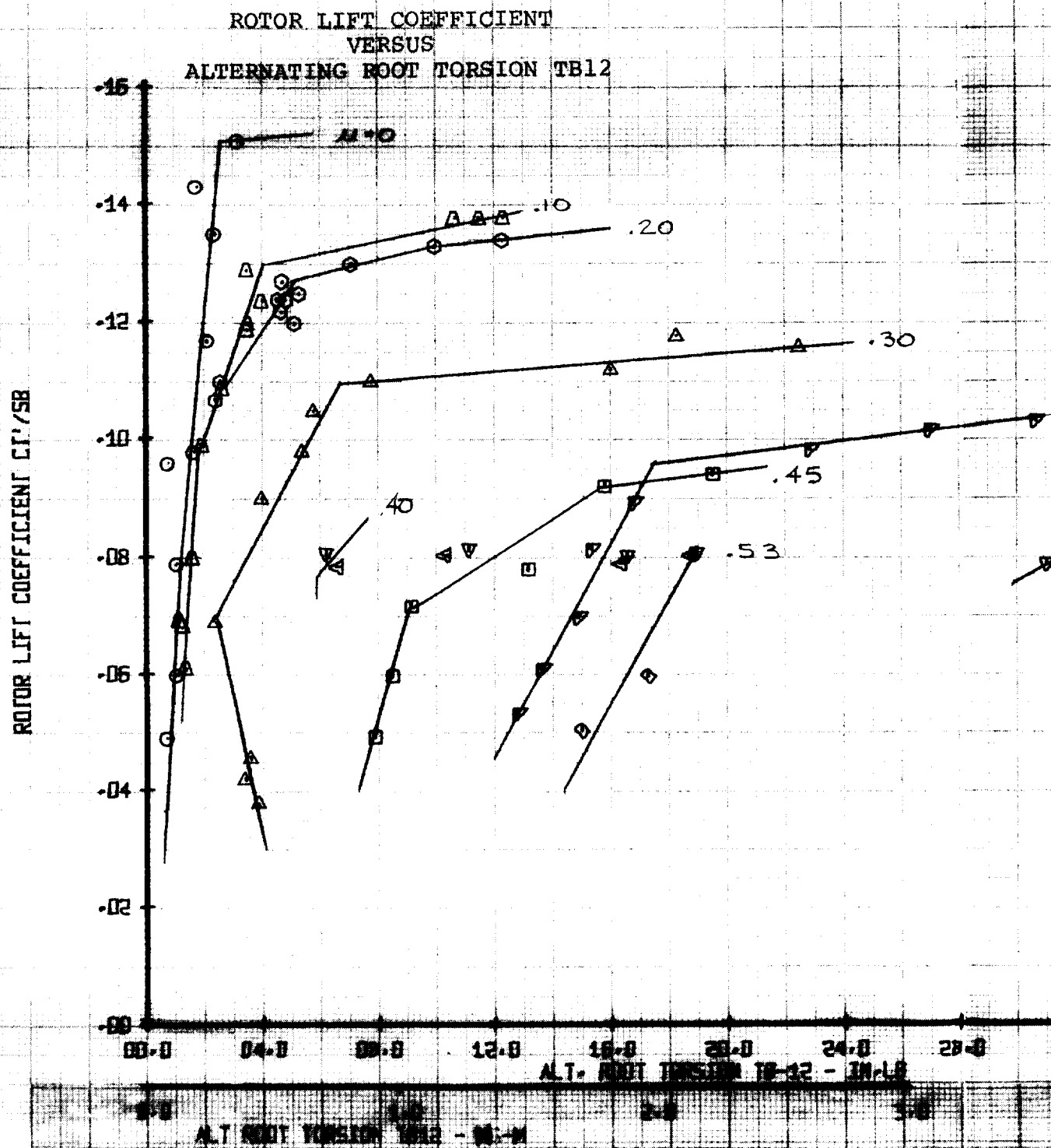
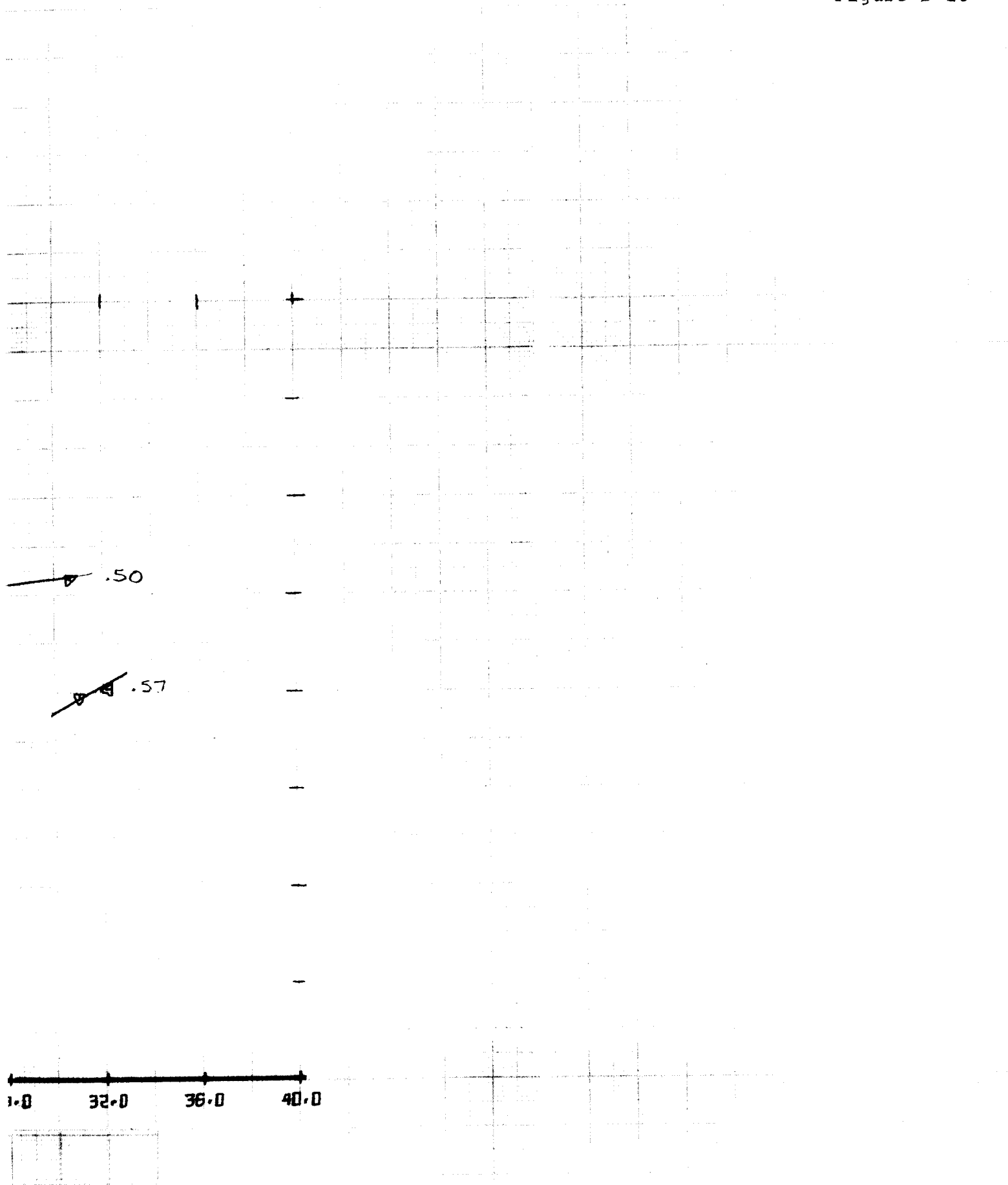


Figure D-18



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	BLN	MLI'	X/DD25B	VTIN
□	250	.40	.05	238
△	251	.45	.05	256
◇	252	.50	.05	285
▽	253	.53	.05	302

ROTOR LIFT COEFFICIENT
VERSUS
SHAFT ANGLE OF ATTACK

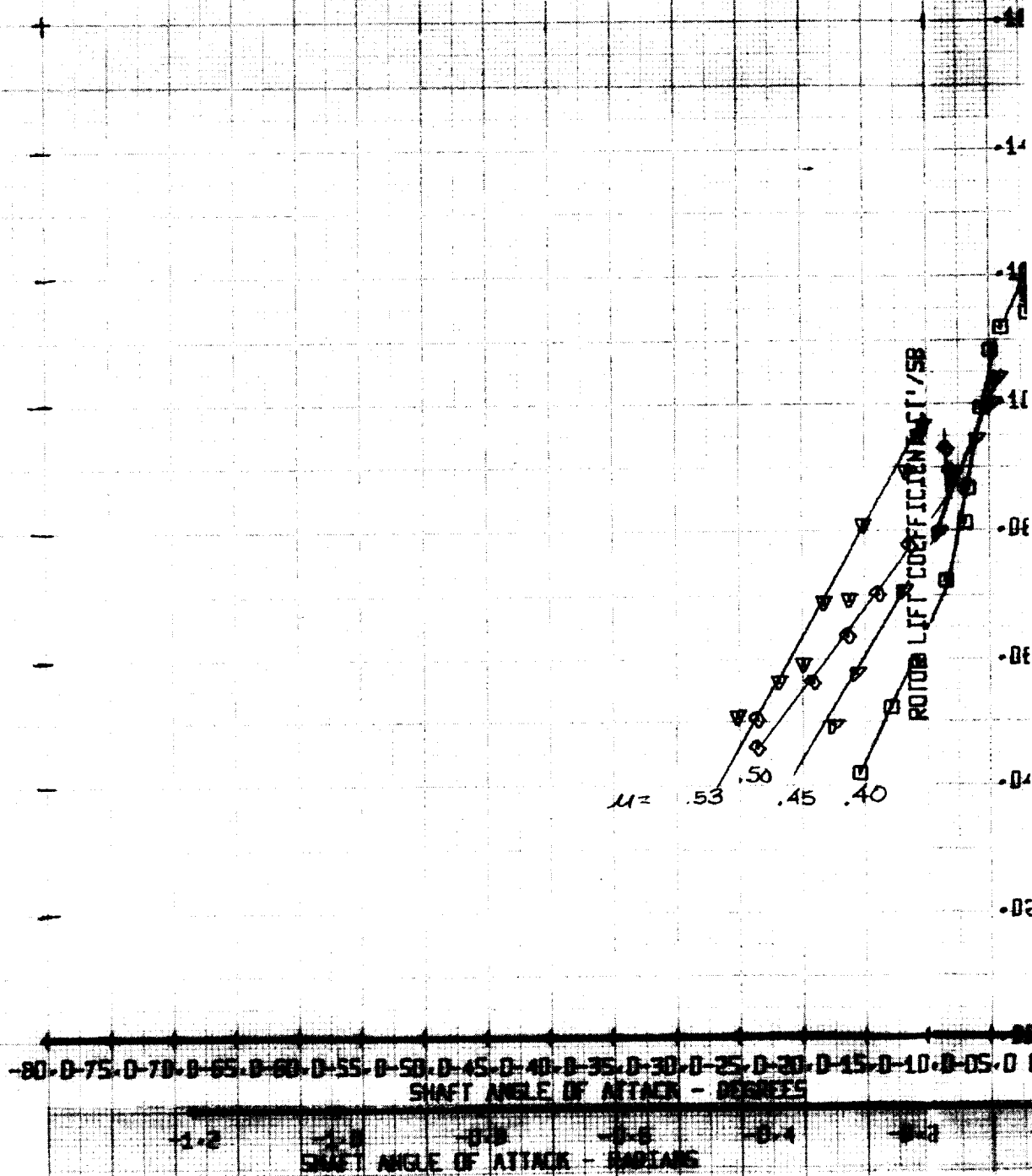
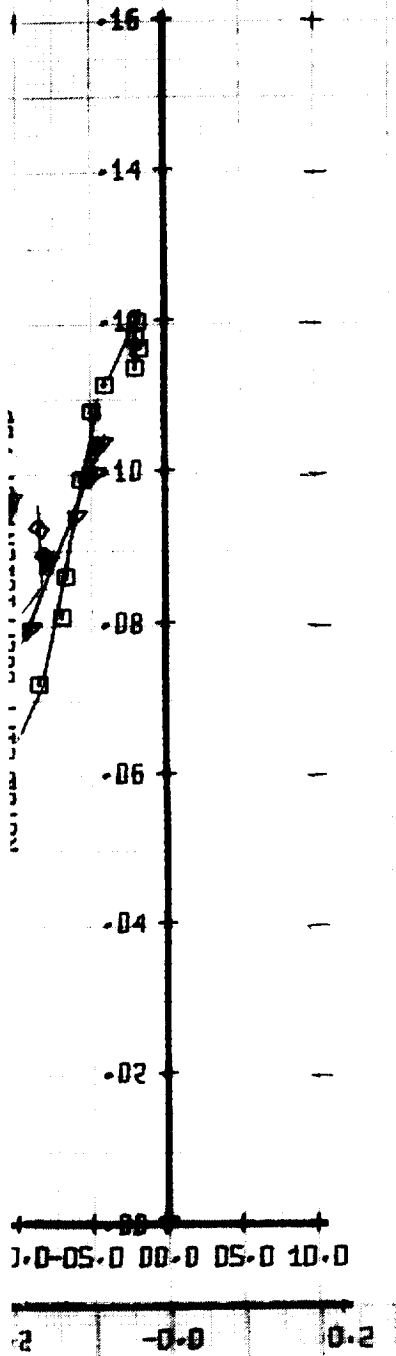


Figure D-19



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	MIN	ML'	X/00258	Y/TIN
□	250	.40	.05	280
△	251	.45	.05	286
◇	252	.50	.05	285
▽	253	.53	.05	302

ROTOR LIFT COEFFICIENT
VERSUS
COLLECTIVE PITCH

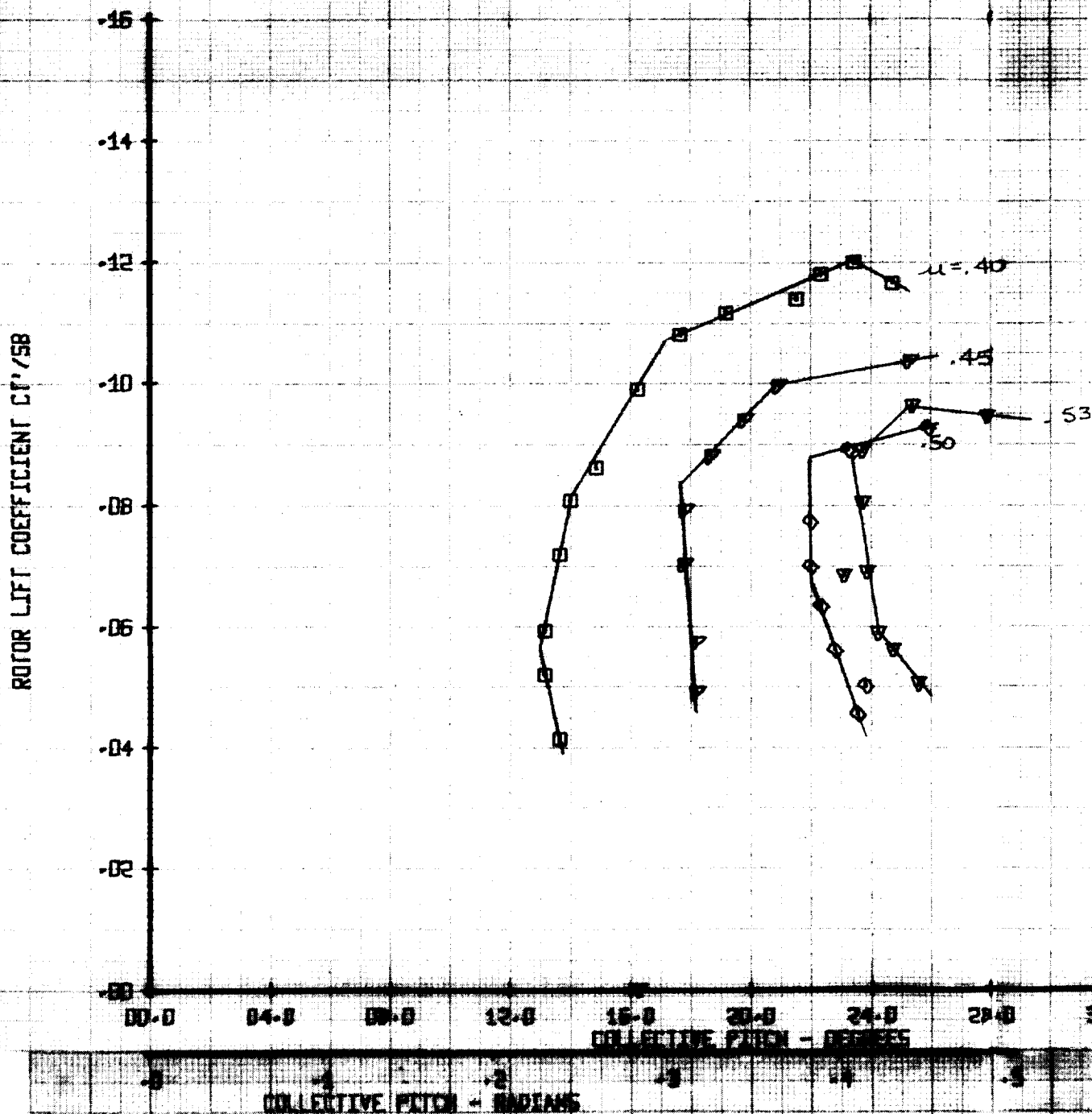


Figure D-20

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM	RUN	MLI'	X/00258	Y/001
□	250	.40	.05	238
△	251	.45	.05	236
◇	252	.50	.05	235
▽	253	.53	.05	302

ROTOR LIFT COEFFICIENT
VERSUS
LONGITUDINAL CYCLIC

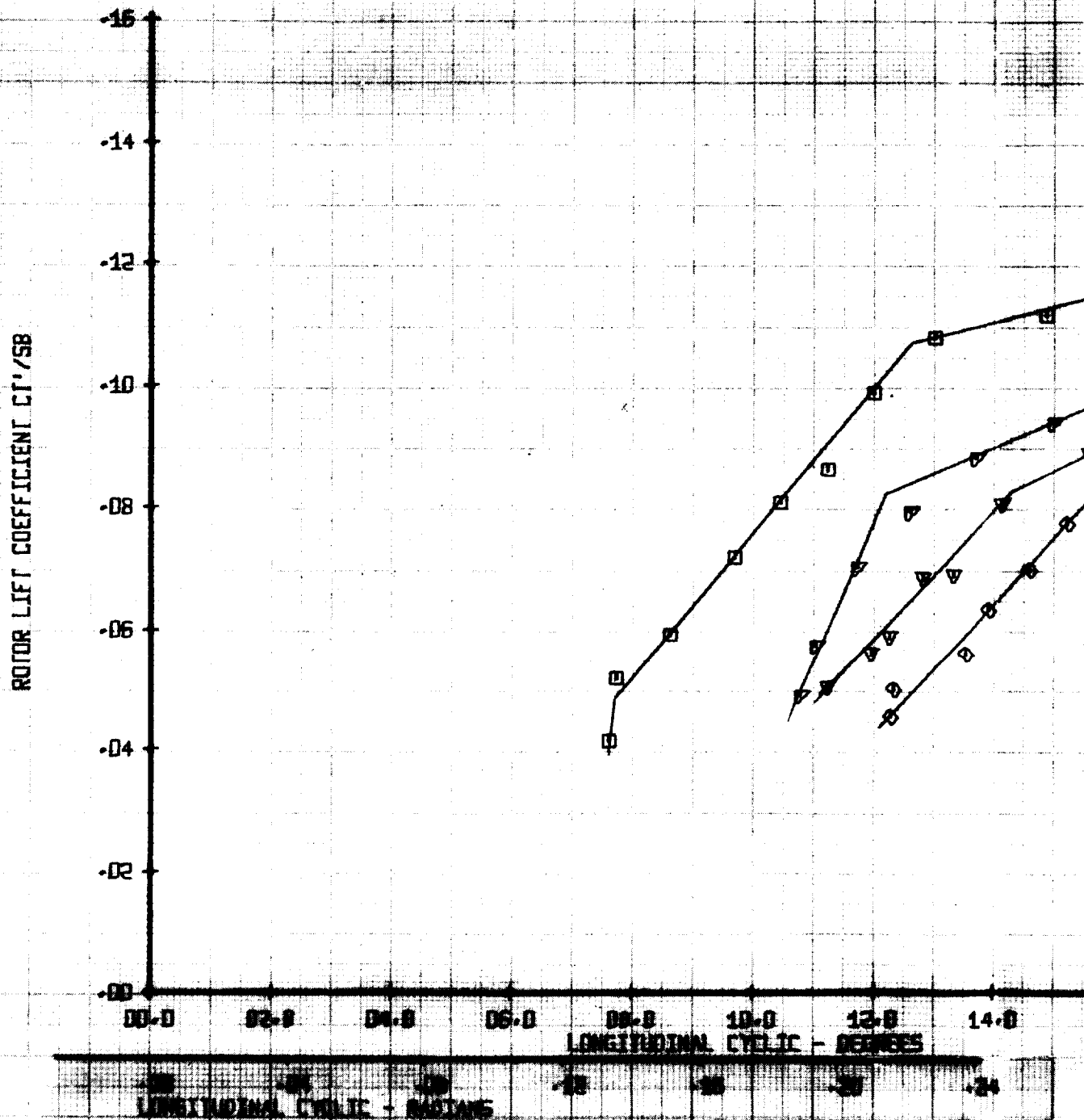
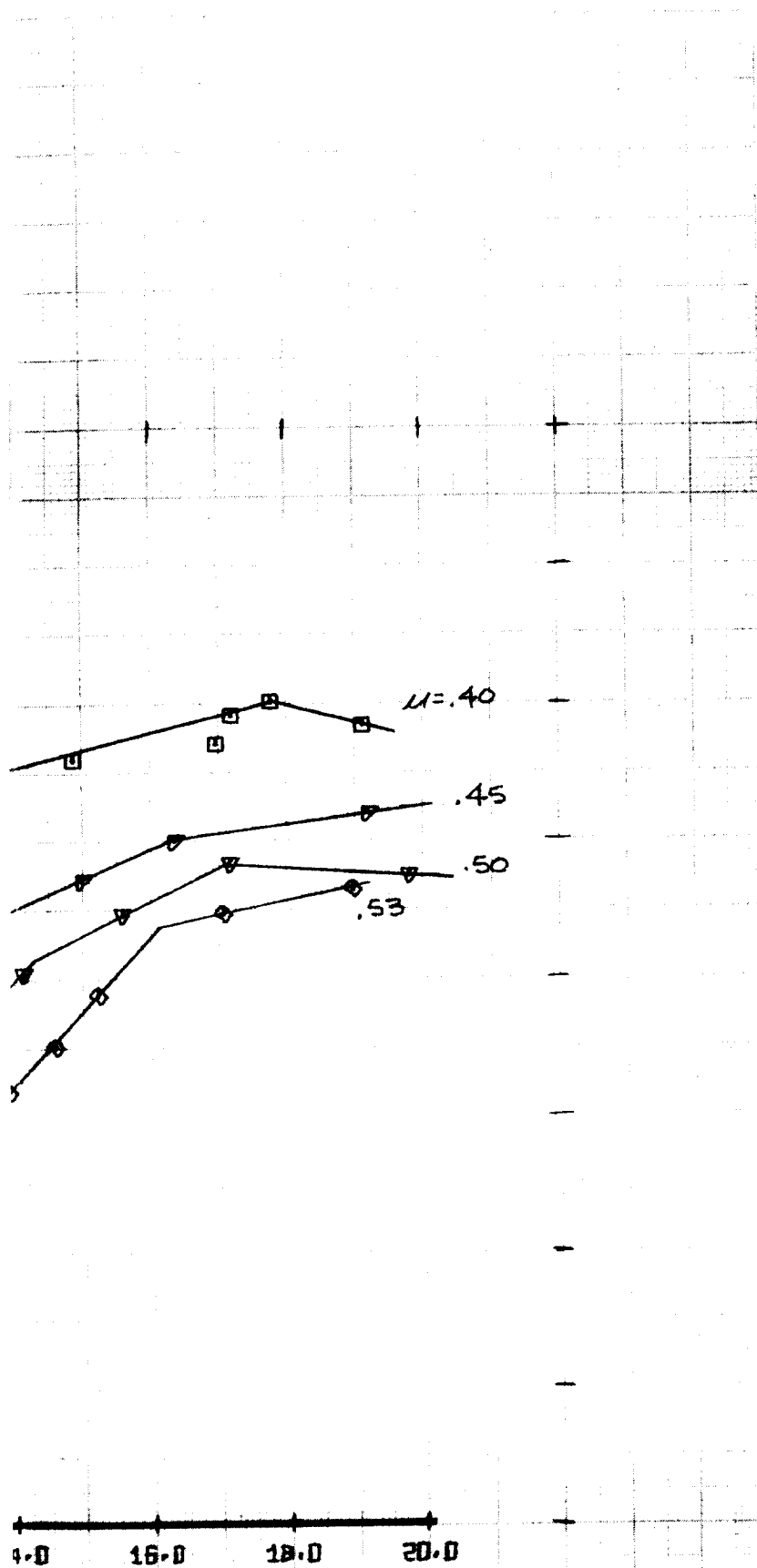


Figure D-21



LIFT-PROPULSIVE FORCE LIMIT TEST

1/10 SCALE CHOP ROTOR

PERFORMANCE SUMMARY

LEGEND				
SYM	QIN	ML'	X/00000	YIN
□	250	.40	.15	220
△	250	.45	.15	226
◇	250	.50	.15	235
▽	250	.53	.15	302

ROTOR LIFT COEFFICIENT

VERSUS

LATERAL CYCLIC

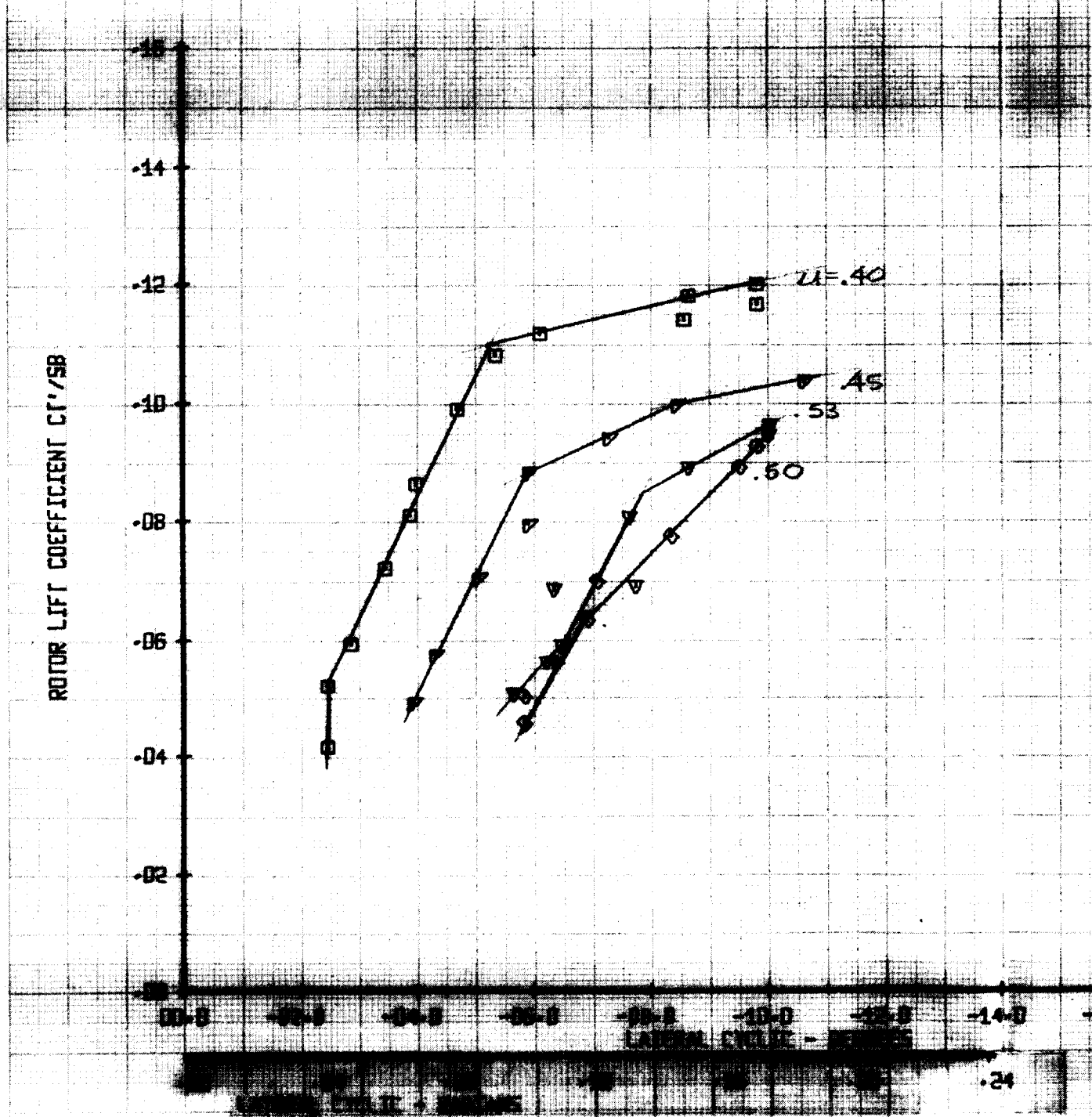
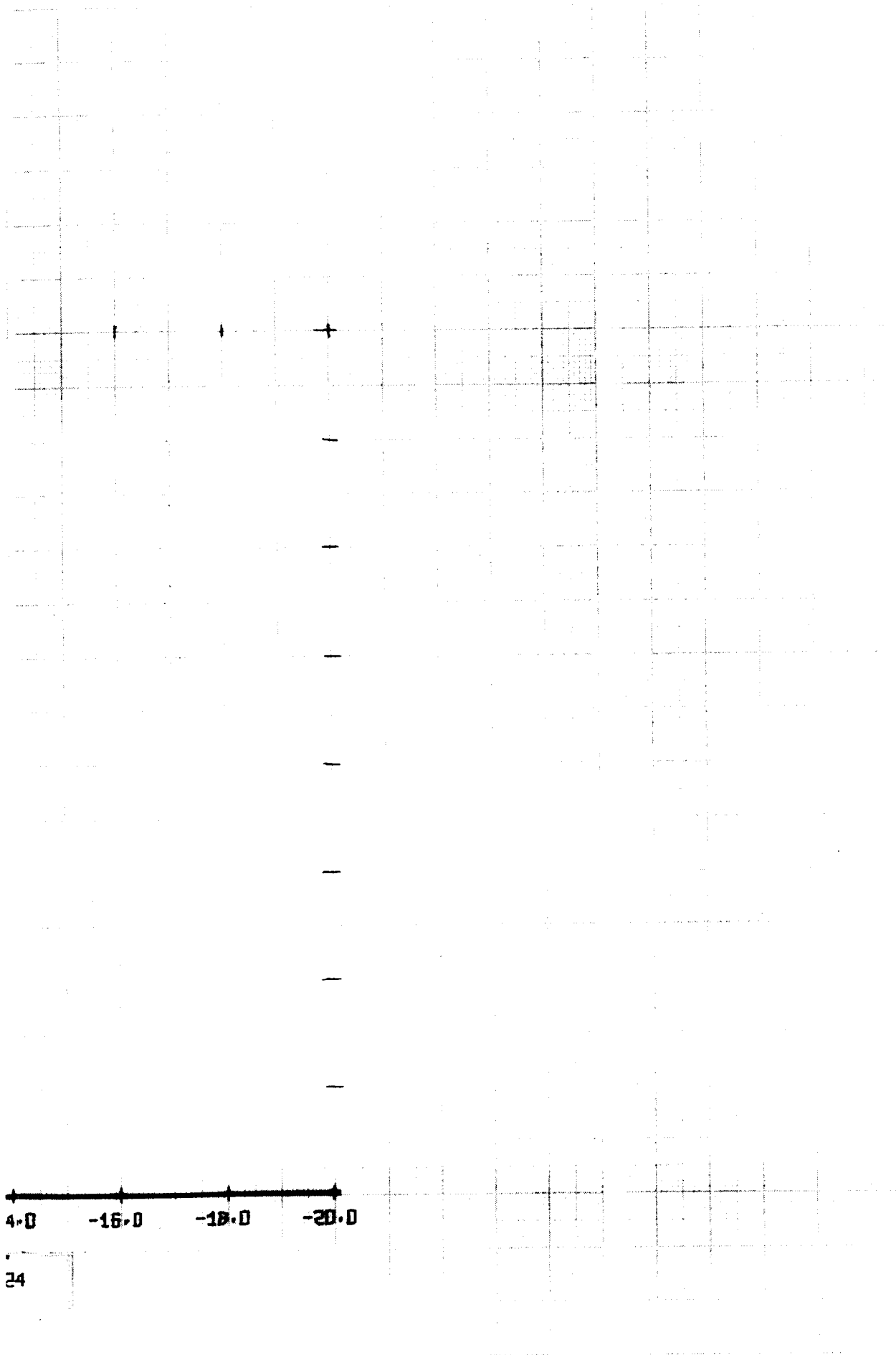


Figure D-22



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM
□
△
◇
△
△

RUN
250
251
252
253

LEGEND

MLI'
.40
.45
.50
.53

X/00258
.05
.05
.05
.05

YTUN
228
236
236
302

ROTOR LIFT COEFFICIENT
VERSUS
ROTOR POWER COEFFICIENT

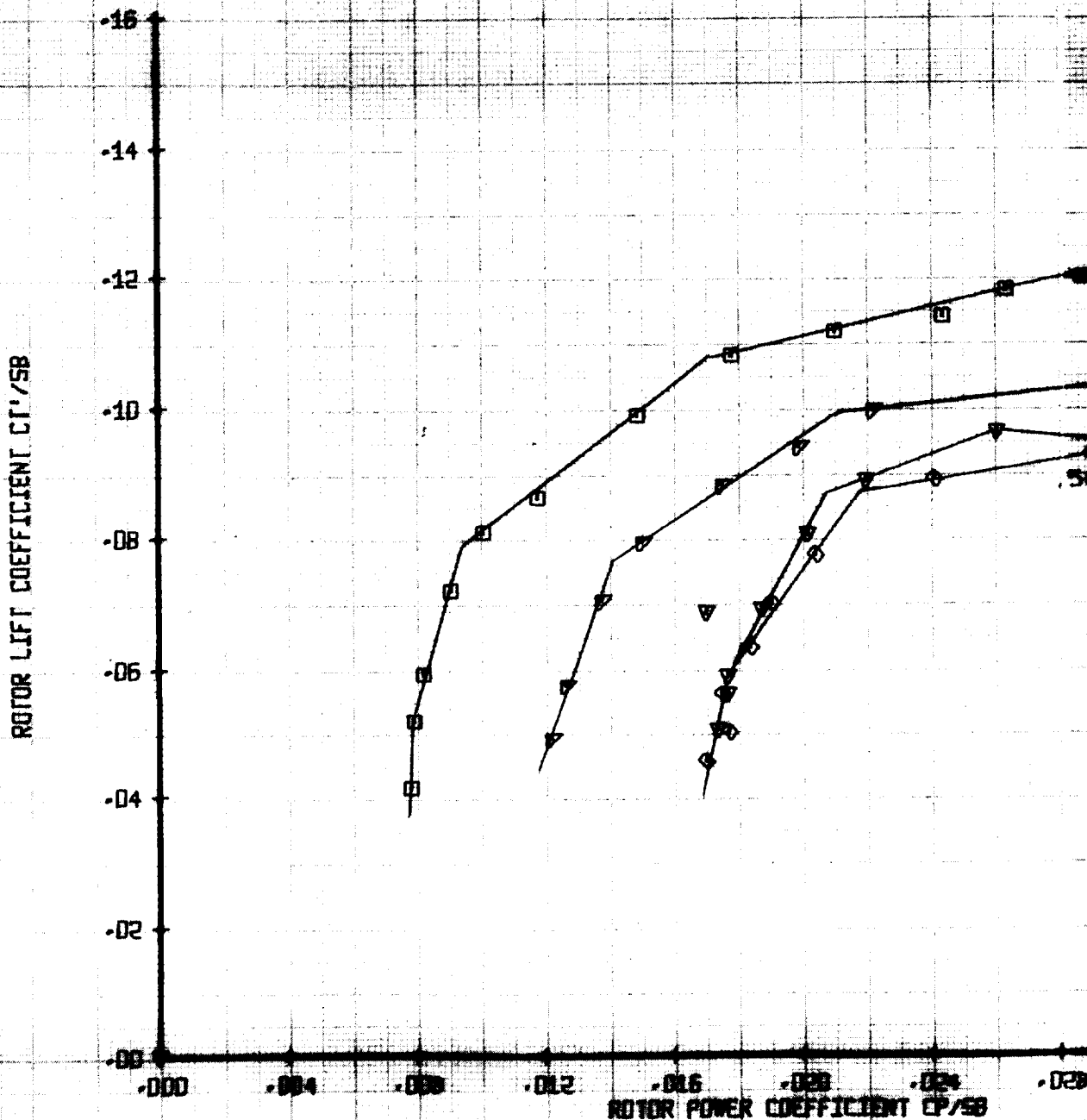
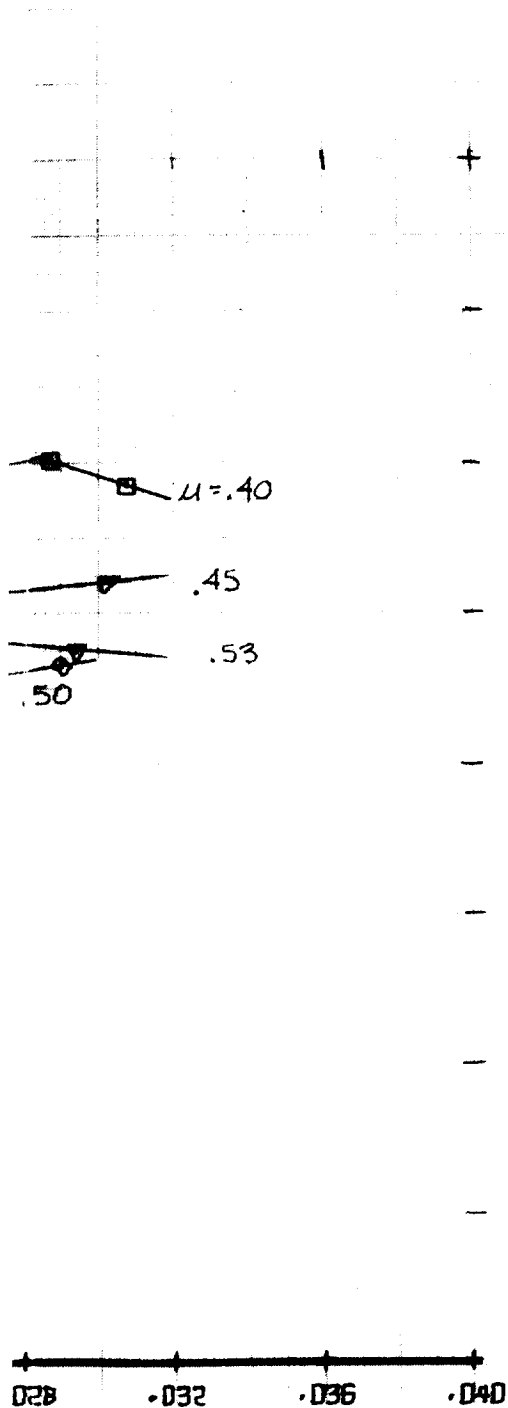


Figure D-23



LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH47B ROTOR
PERFORMANCE SUMMARY

SYM
□
△
◇
▽

MAN
0.40
0.45
0.50
0.53

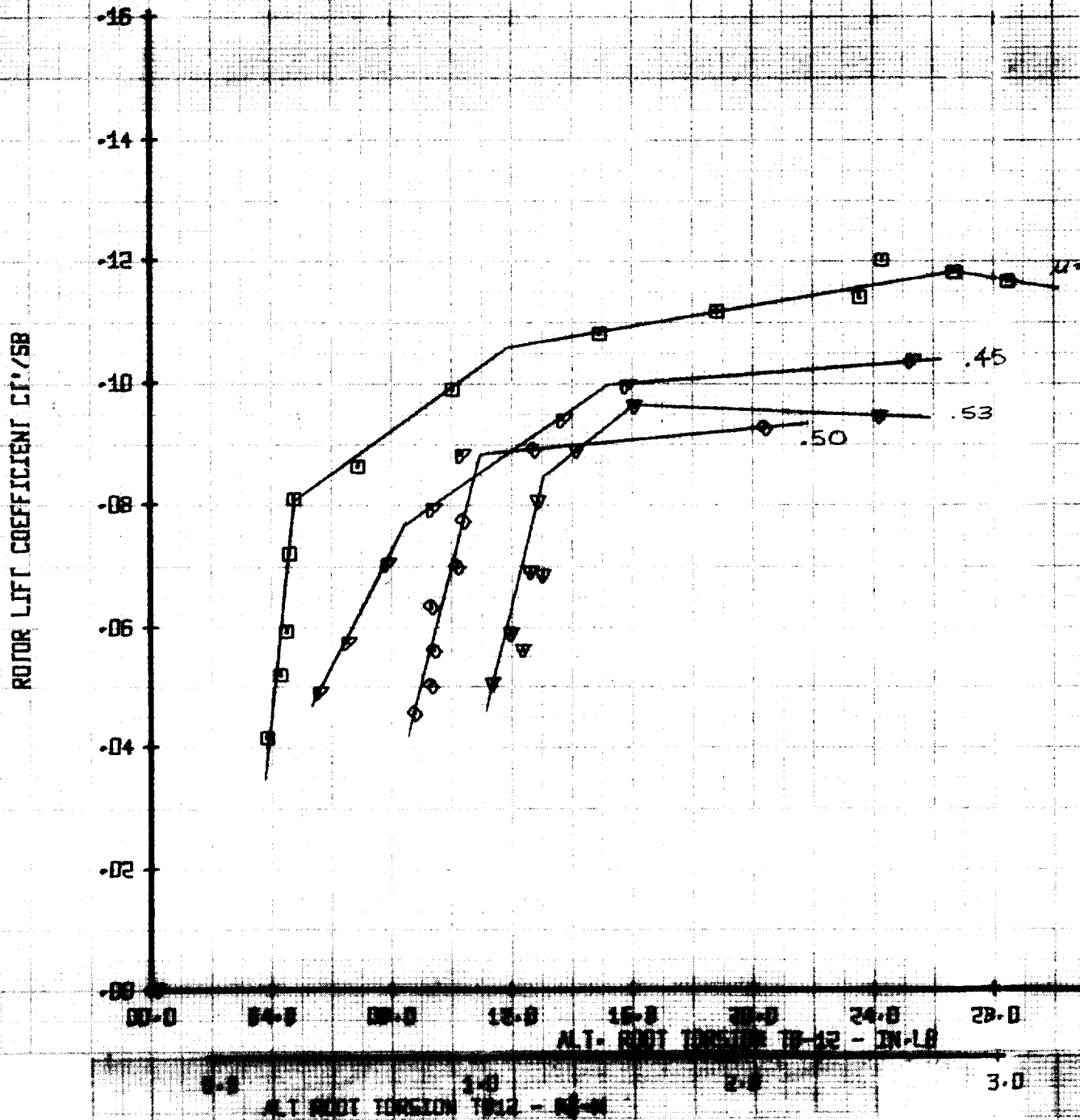
LEGEND

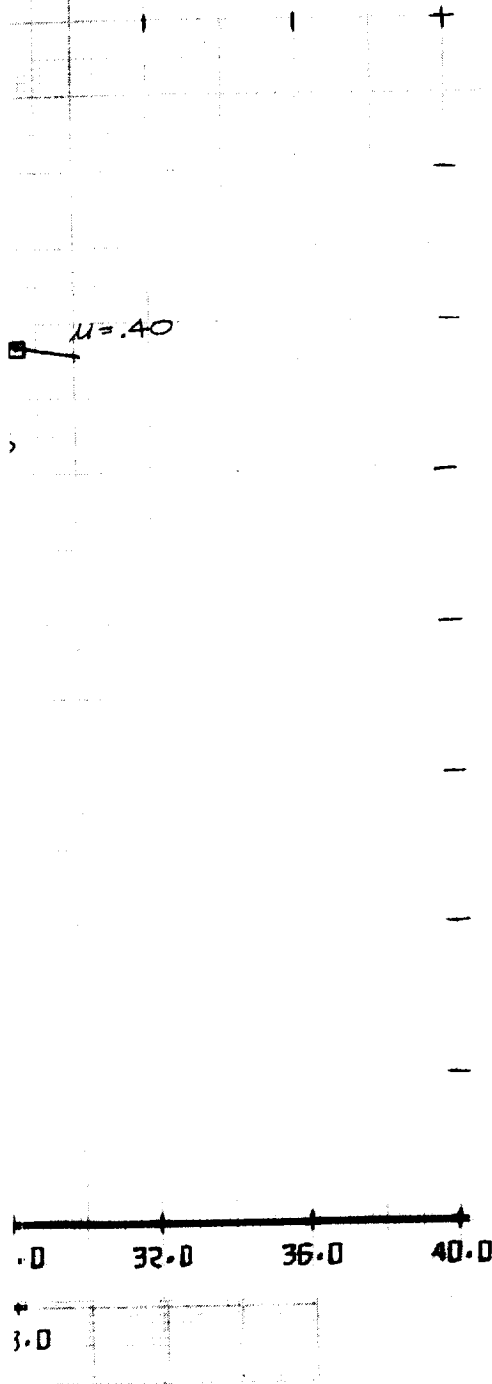
MU'
.40
.45
.50
.53

X/00258
.05
.05
.05
.05

Y/TM
0.40
0.45
0.50
0.53

ROTOR LIFT COEFFICIENT
VERSUS
ALTERNATING ROOT TORSION TB12





E. Effect of Torsional Stiffness

At the end of the first portion of the test program, a model control system problem caused the destruction of a set of standard blades. A set of rotor blades that were geometrically the same but with a reduced torsional stiffness were selected for interim testing. These soft GJ blades had a torsional stiffness that was reduced by 45 percent of the standard blades. After installing these blades on the model, a run was conducted to determine the frequency spectrum, shown in Figure E-1, at an advance ratio of 0.30 and a rotor lift coefficient of 0.06. Following this run, a forward flight run was made at an advance ratio of 0.57 to determine the lift limit. This data obtained is presented in Figures E-2 through E-17. A second forward flight run was attempted but a severe model problem was encountered which finished Part 1 of the test program.

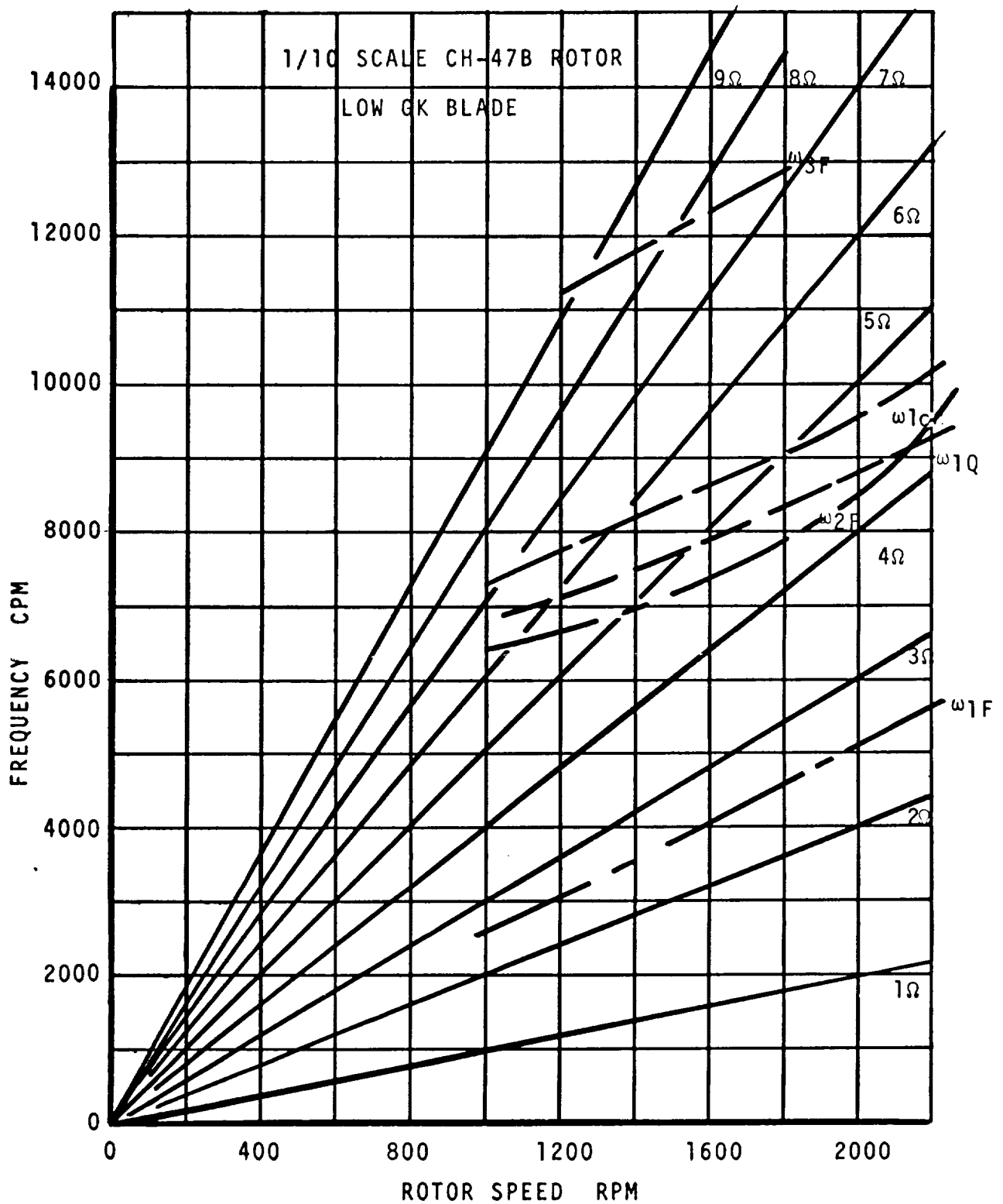


FIGURE E-1 FREQUENCY SPECTRUM FOR TORSIONALLY SOFT BLADE

Figure E-2

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

LEGEND
SYM RUN MU' X/QD2SB VTUN
◇ 56 .57 .05 350

ROTOR LIFT COEFFICIENT
VERSUS
ROTOR PROPULSIVE FORCE COEFFICIENT

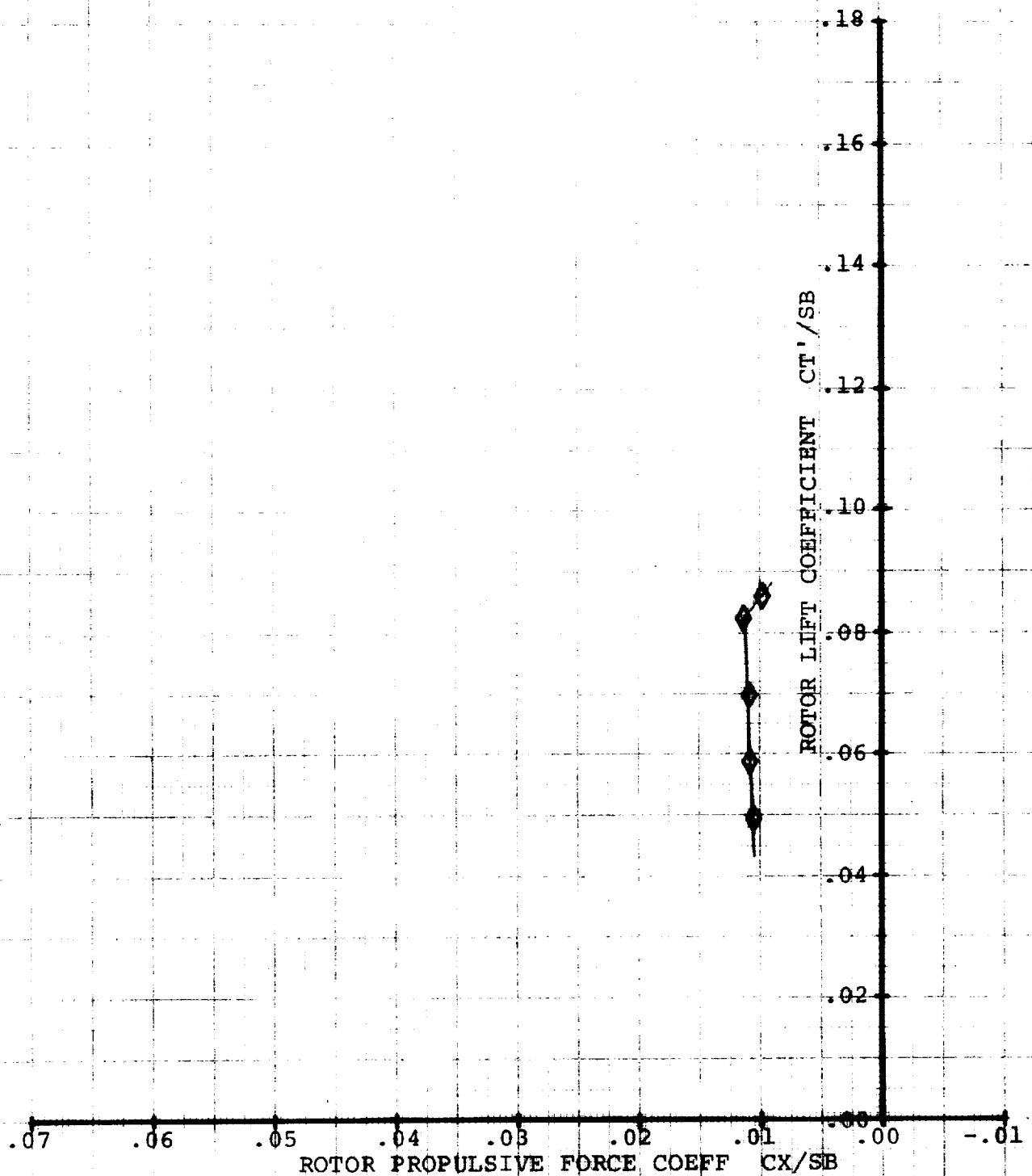


Figure E-3

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

SYM

RUN

56

LEGEND

MU'

.57

X/QD2SB

.05

VTUN

350

ROTOR LIFT COEFFICIENT
VERSUS
SHAFT ANGLE OF ATTACK

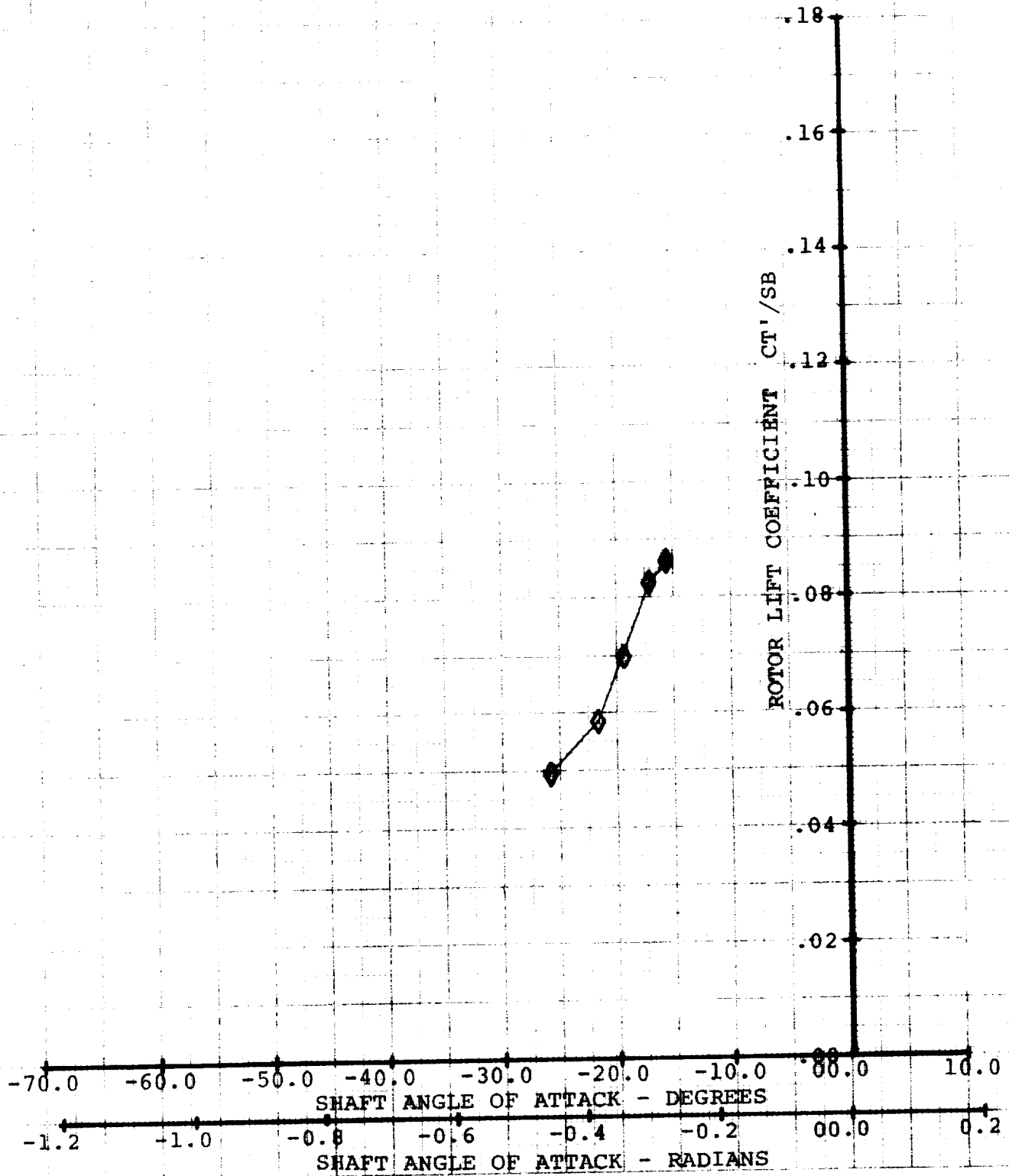


Figure E-4

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

SYM
◇

RUN
56

LEGEND

MU'
.57

X/QD2SB
.05

VTUN
350

ROTOR LIFT COEFFICIENT
VERSUS
COLLECTIVE PITCH

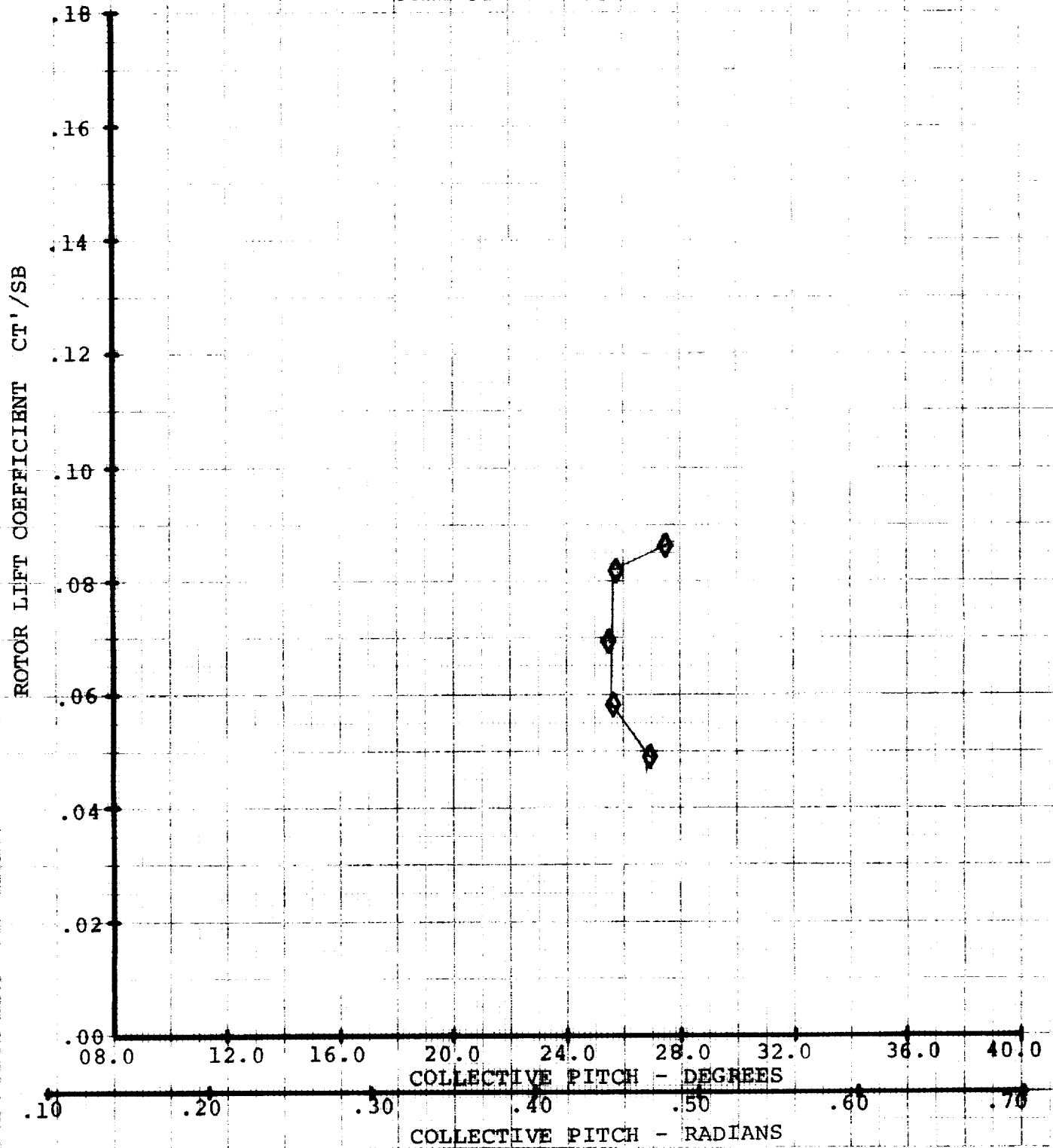


Figure E-5

LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 LIFT LIMIT TESTING

SYM
 ◇

RUN
 56

LEGEND

MU'
 .57

X/QD2SB
 .05

VTUN
 350

ROTOR LIFT COEFFICIENT
 VERSUS
 LONGITUDINAL CYCLIC

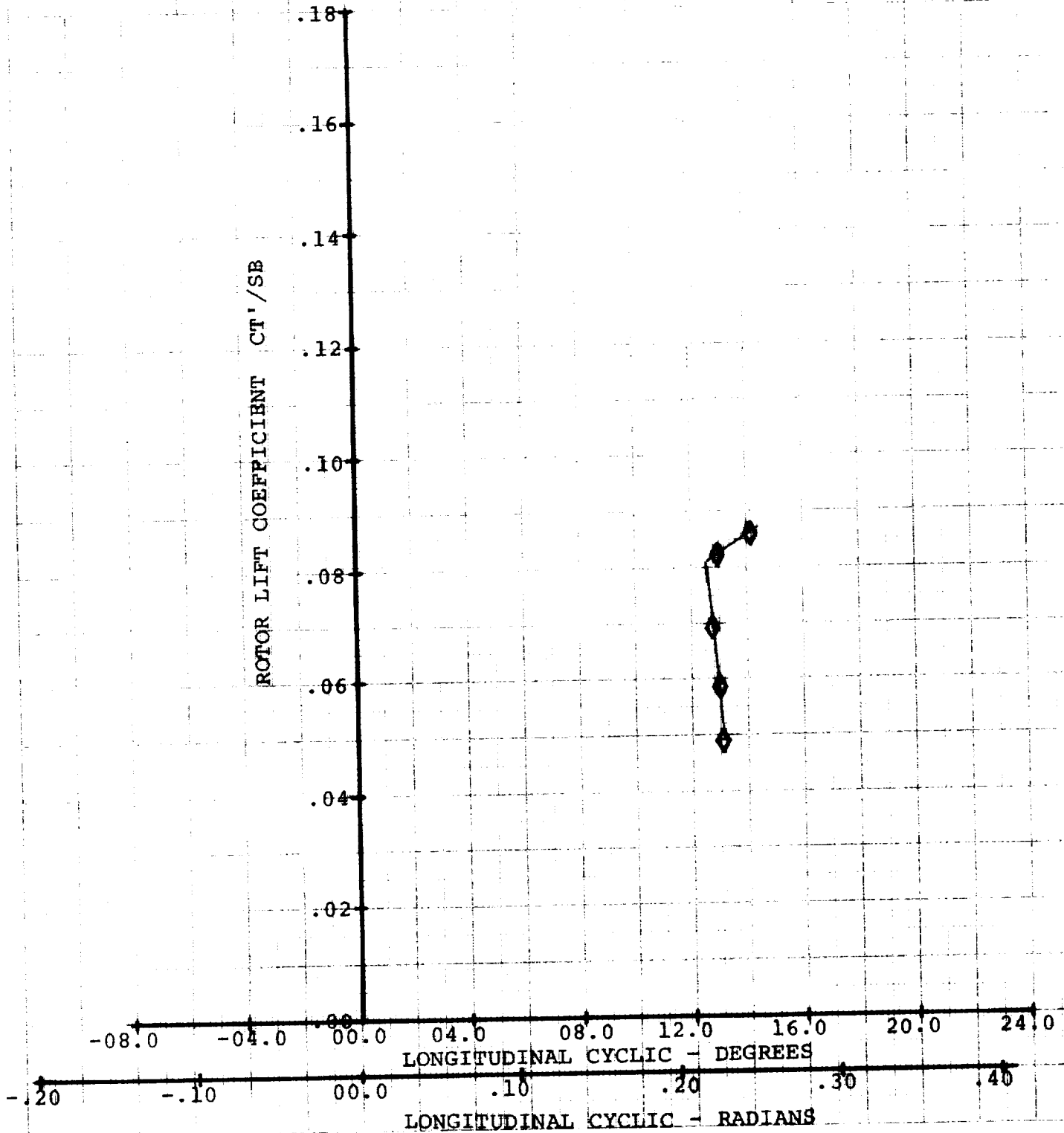


Figure E-6

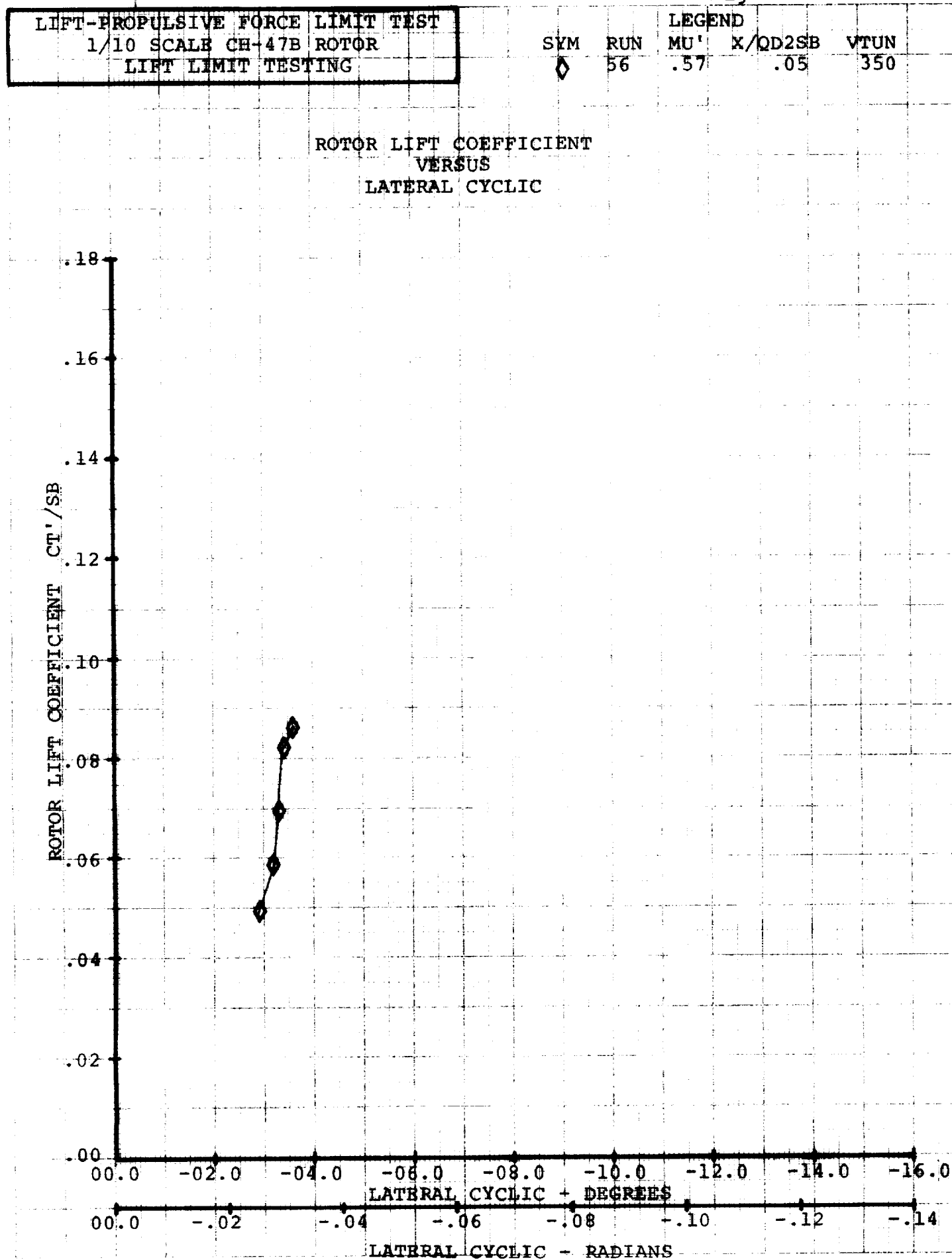


Figure E-7

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

SYM

RUN

LEGEND

MU'

X/QD2SB

VTUN

56

.57

.05

350

ROTOR LIFT COEFFICIENT
VERSUS
ROTOR POWER COEFFICIENT

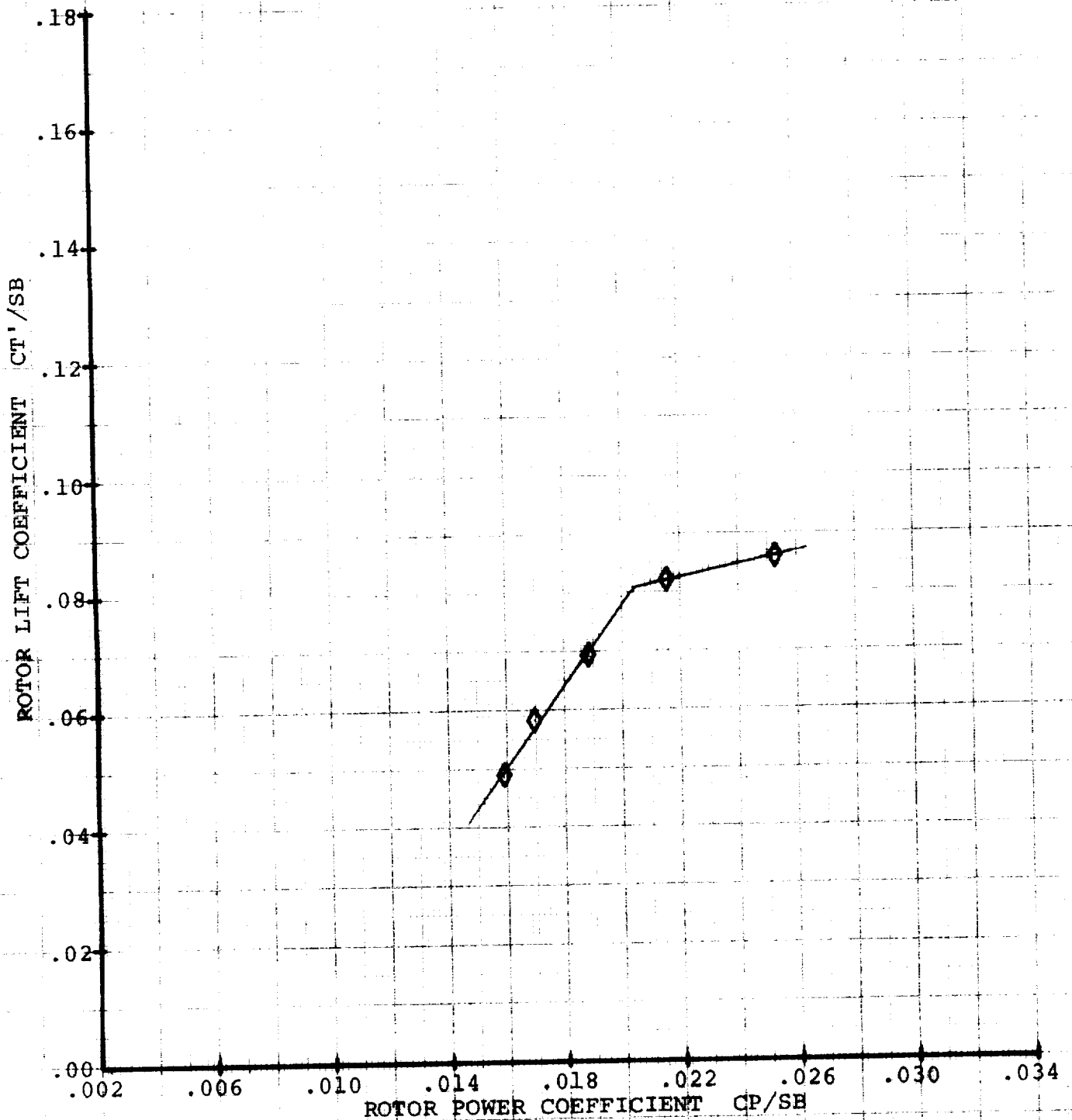


Figure E-8

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

LEGEND
SYM RUN MU' X/QD2\$B VTUN
◇ 56 .57 .05 350

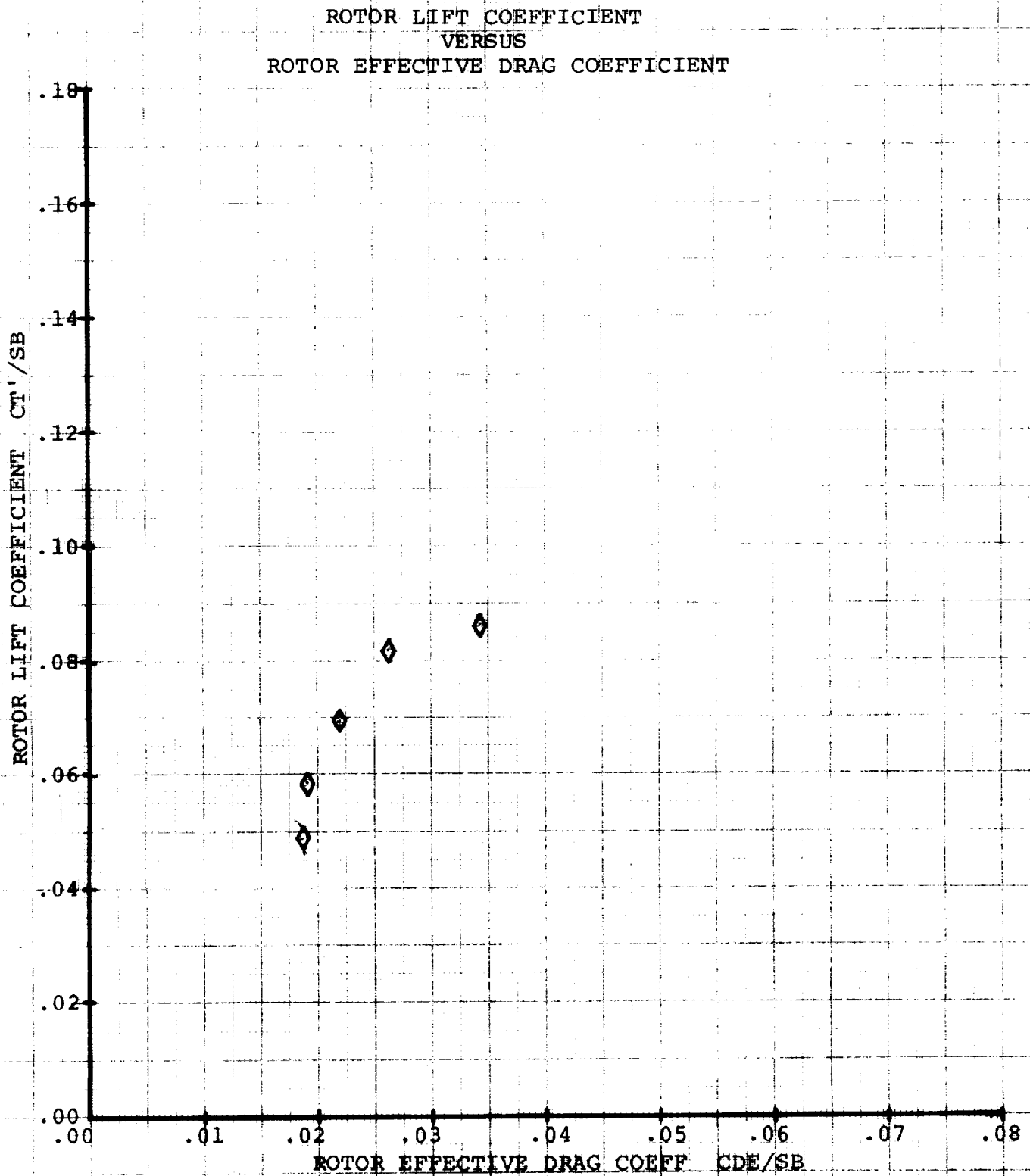


Figure E-9

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

SYM RUN MU' X/QD2SB VTUN
◇ 56 .57 .05 350

ROTOR LIFT COEFFICIENT
VERSUS
ROTOR PITCHING MOMENT

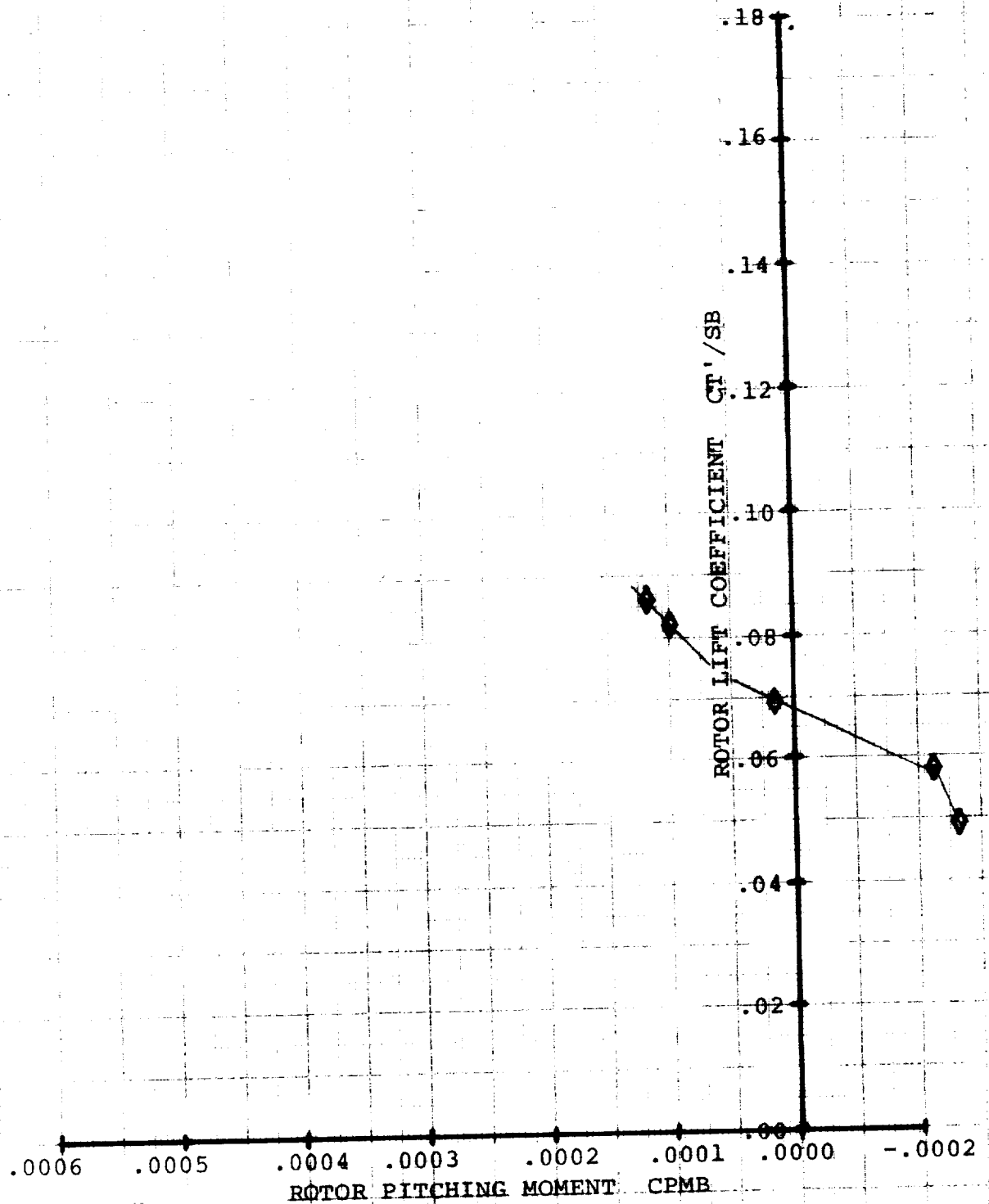


Figure E-10

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

SYM RPN
◇ 56

LEGEND
MU' X/QD2SB VTUN
.57 .05 350

ROTOR LIFT COEFFICIENT
VERSUS
ROTOR ROLLING MOMENT COEFFICIENT

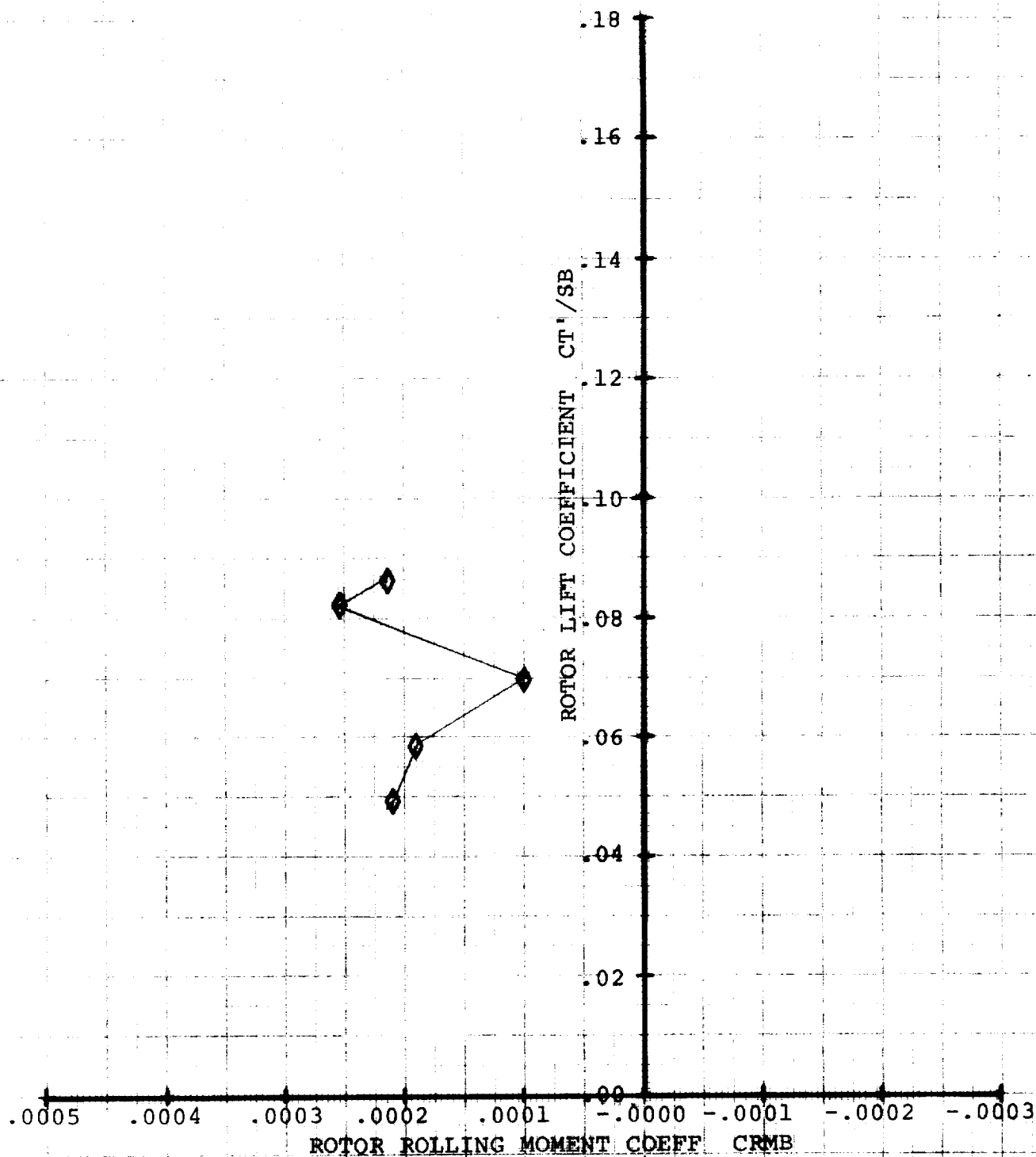


Figure E-11

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

SYM

RUN

LEGEND

MU'

X/QD2SB

VTUN

◇

56

.57

.05

350

ROTOR LIFT COEFFICIENT
VERSUS
ROTOR LONGITUDINAL FORCE COEFFICIENT

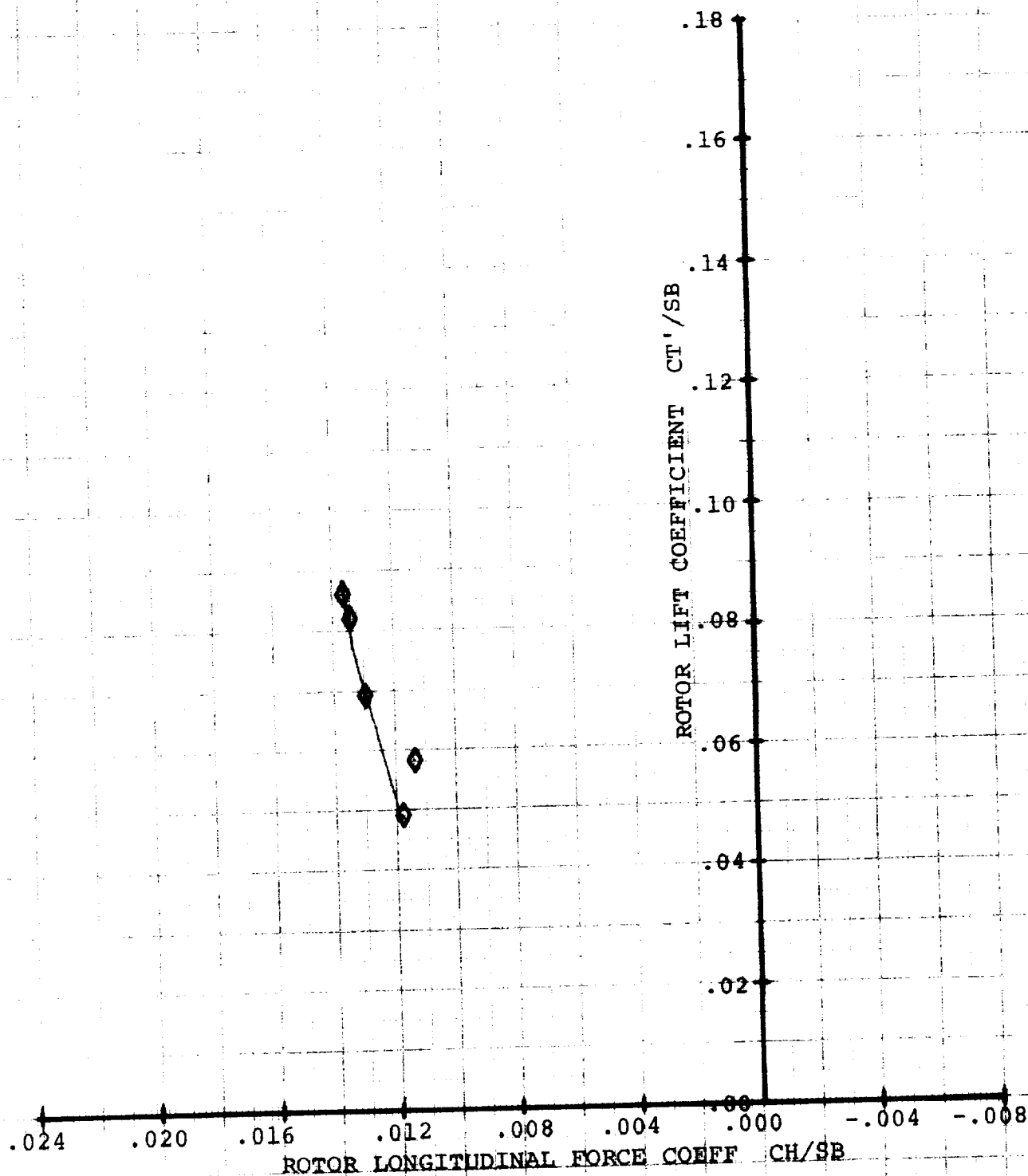


Figure E-12

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

SYM	RUN	MU'	X/QD2SB	VTUN
0	56	.57	.05	350

ROTOR LIFT COEFFICIENT
VERSUS
ROTOR SIDE FORCE COEFFICIENT

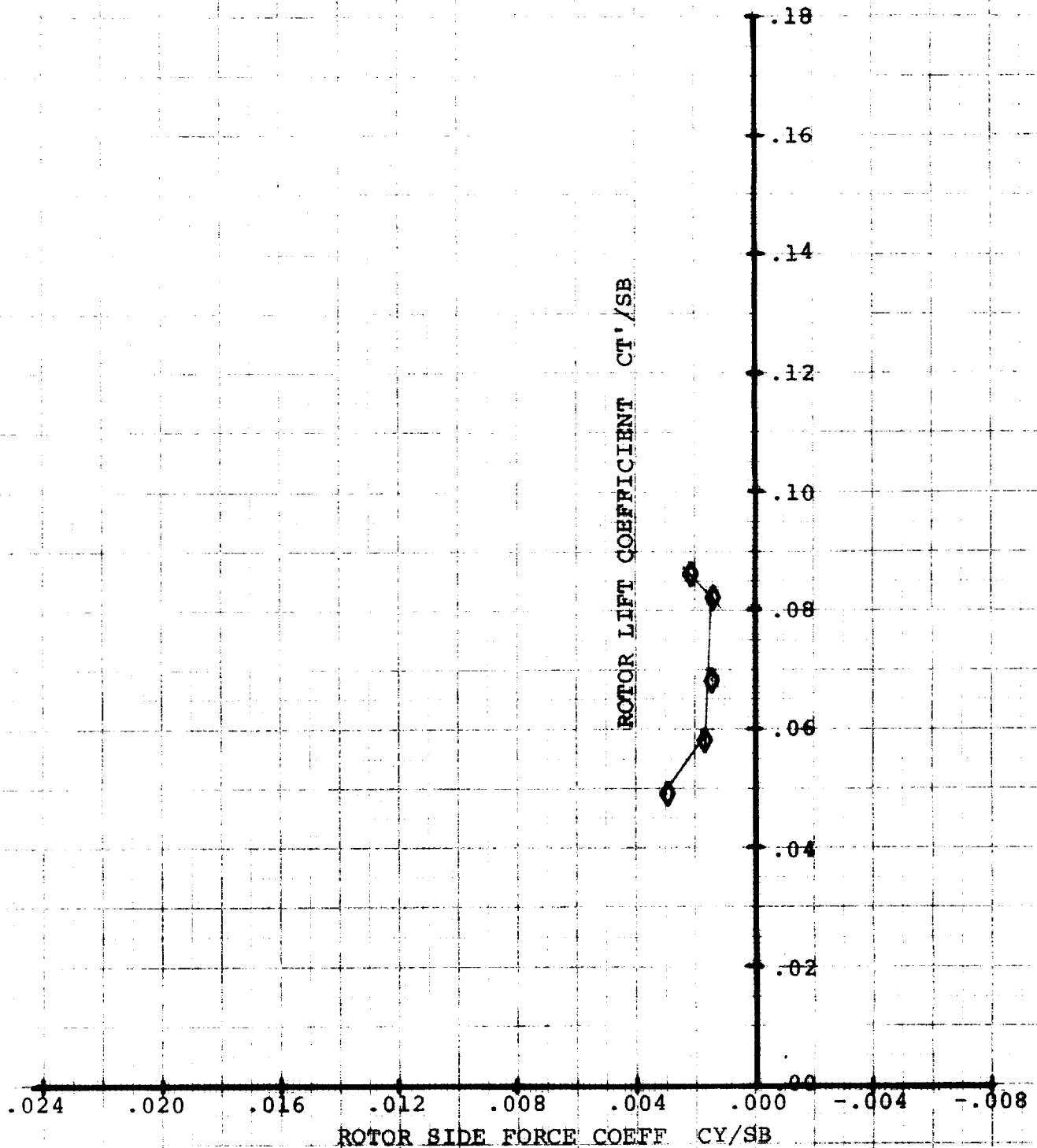


Figure E-13

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

LEGEND
SYM RUN MU' X/QD2SB VTUN
◇ 56 .57 .05 350

ROTOR LIFT COEFFICIENT
VERSUS
ALTERNATING ROOT TORSION TB12

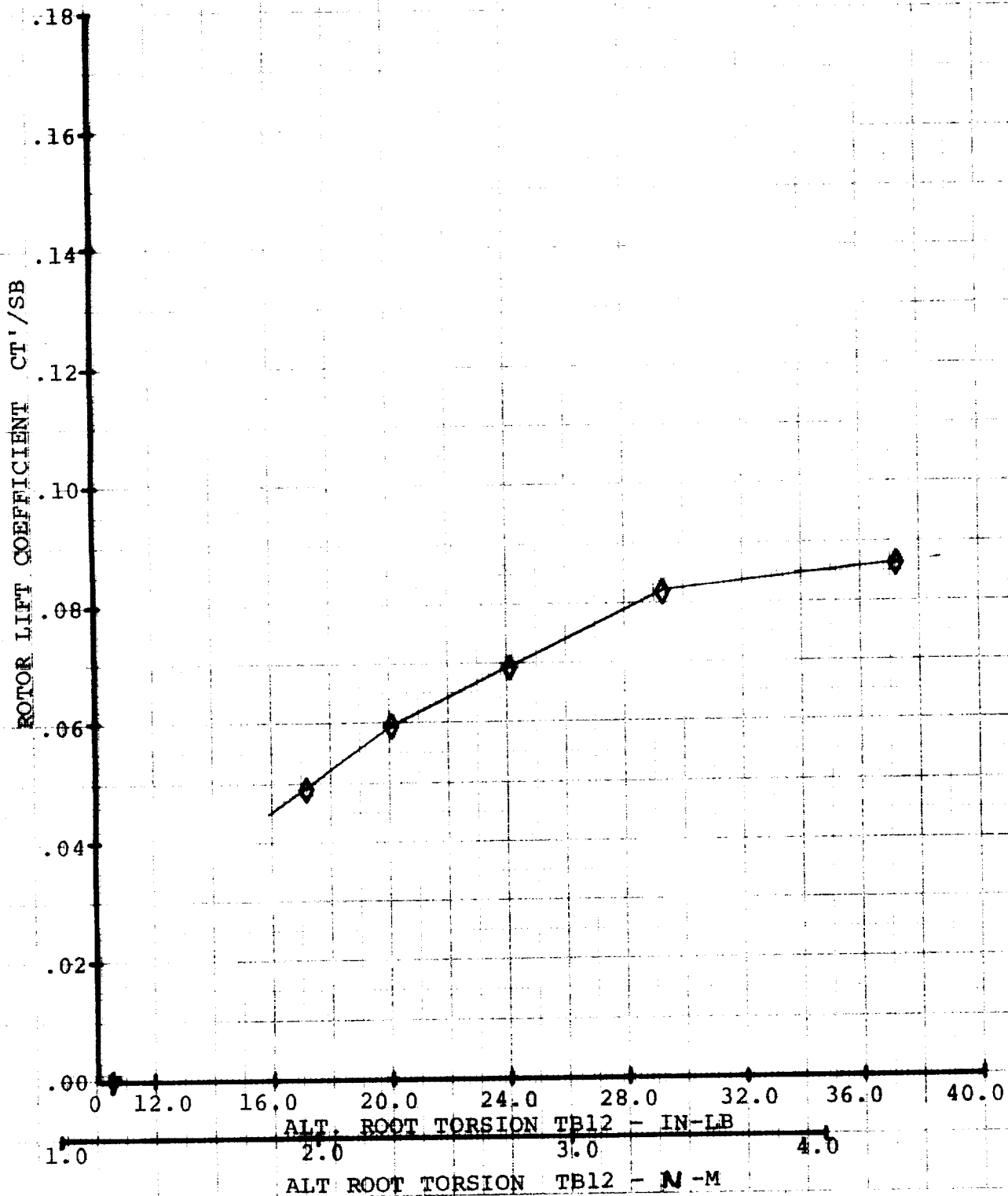


Figure E-14

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

SYM RUN MU' X/QD2SB VTUN
0 56 .57 .05 350

ROTOR LIFT COEFFICIENT
VERSUS
ALTERNATING ROOT FLAP BENDING FB12

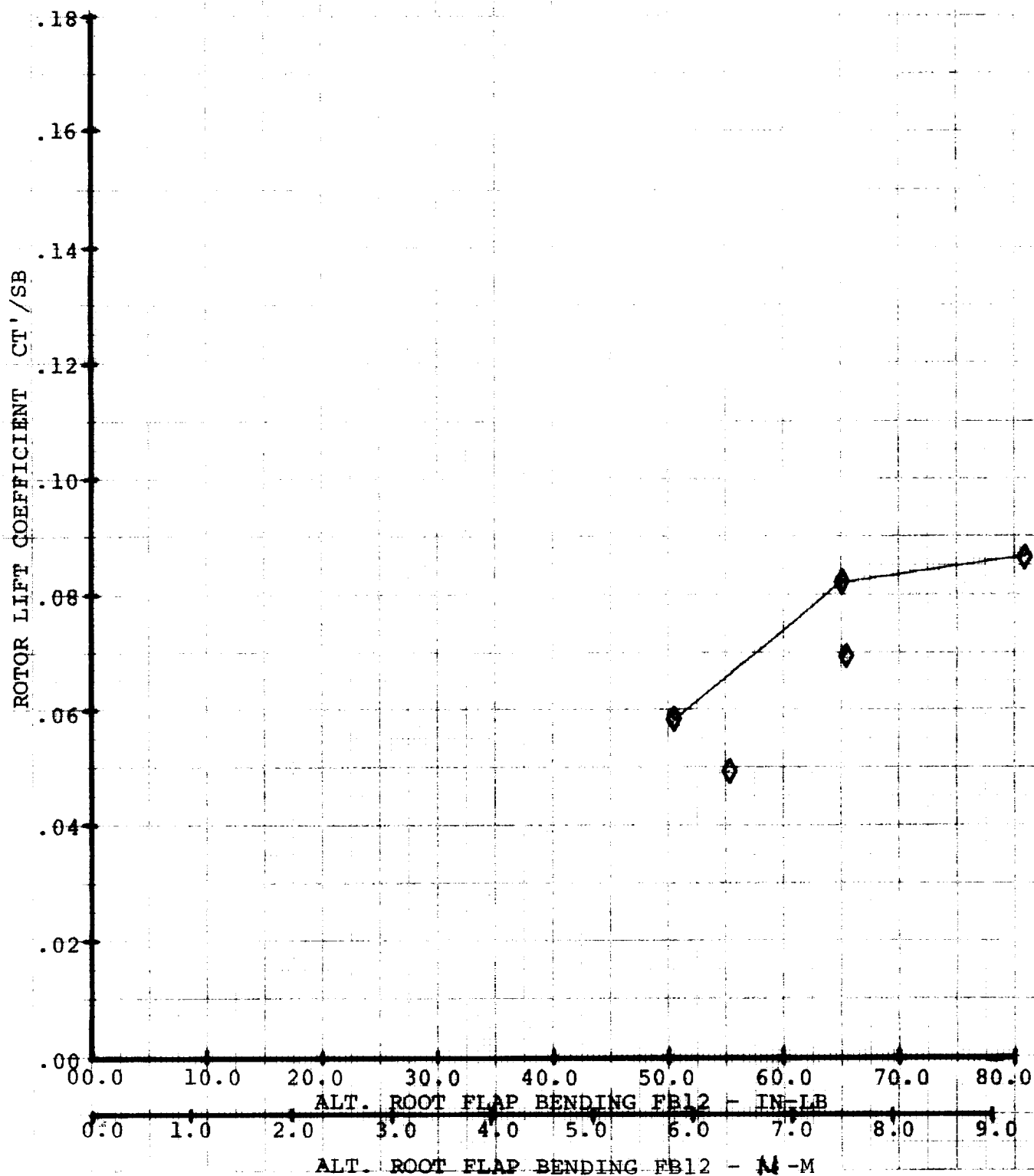
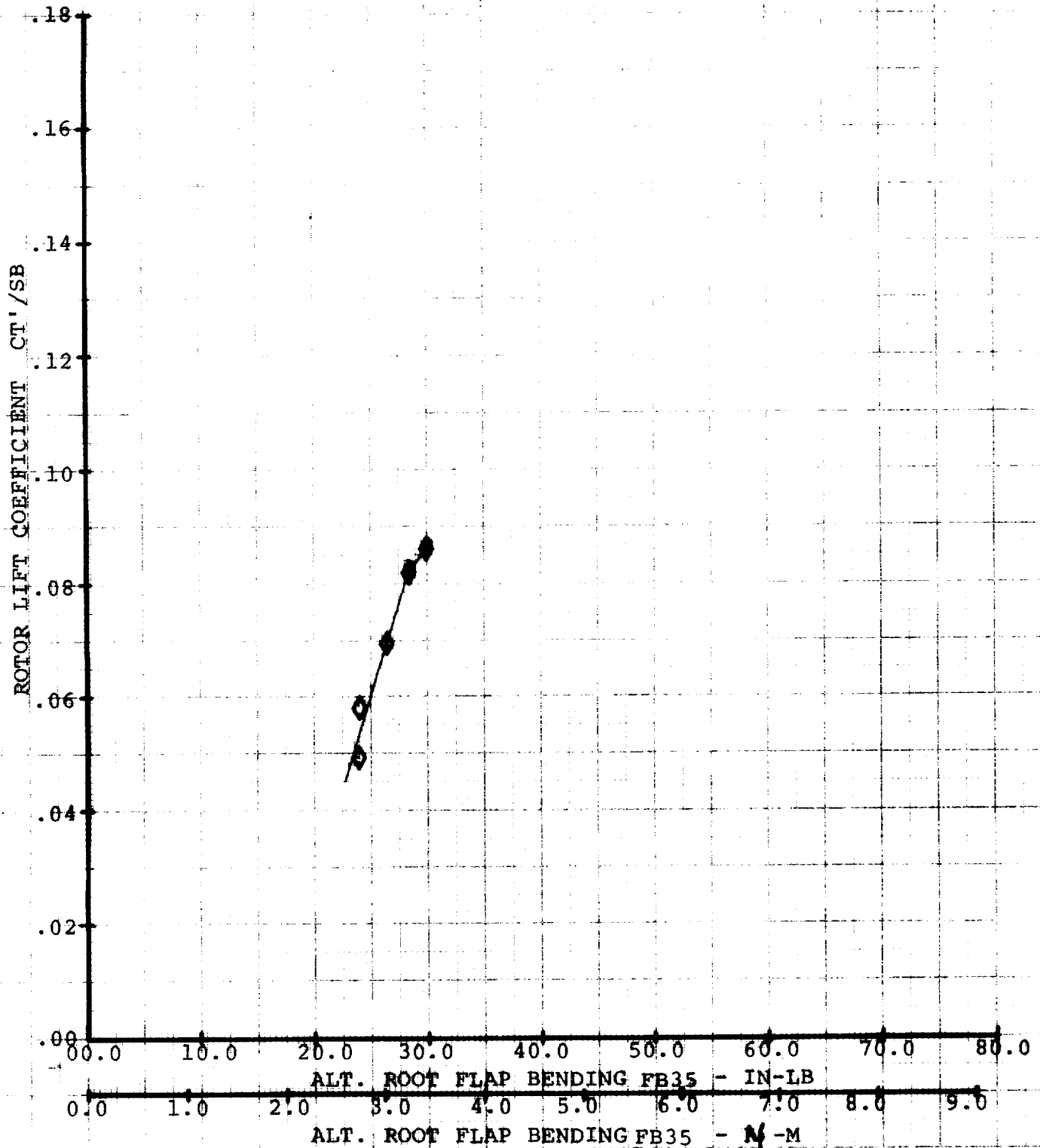


Figure E-15

LIFT-PROPULSIVE FORCE LIMIT TEST
1/10 SCALE CH-47B ROTOR
LIFT LIMIT TESTING

LEGEND
SYM RUN MU' X/QD2SB VTUN
◇ 56 .57 .05 350

ROTOR LIFT COEFFICIENT
VERSUS
ALTERNATING ROOT FLAP BENDING FB35



LIFT-PROPULSIVE FORCE LIMIT TEST
 1/10 SCALE CH-47B ROTOR
 LIFT LIMIT TESTING

LEGEND
 SYM RUN MU' X/QD2SB VTUN
 56 .57 .05 350

ROTOR LIFT COEFFICIENT
 VERSUS
 ALTERNATING ROOT CHORD BENDING CB12

